HOW TO GUIDE BOOKLET ON DISASTER RESILIENT LOW -COST HOUSE FOR DROUGHT PRONE AREA

CARITAS BANGLADESH
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Publisher	**Caritas Bangladesh** **House # 02, Outer Circular Road** **Shantibagh, Dhaka 1217** **BANGLADESH**
1st Edition	**October, 2018**
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Financial Aid	**Secours Catholique, Caritas, France**
Technical Assistance	**Bangladesh University of Engineering and Technology-BUET and** **CRAterre, France**
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Printing	**Shovon Printing and Enterprise** **1/2, Purba Tejgaon Bazaar, Dhaka 1215** **Cell # 0088-01718-041769**
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PREFACE

Caritas Bangladesh commenced its disaster management program and initiated relevant activities to serve the disaster-affected community in the background of cataclysmic November 12, 1970 Cyclone and Storm Surge in the southern part of the country as well as to respond to dire needs of millions affected by nine-month long 1971 Bangladesh War of Liberation.

Bangladesh is one of world's most disaster-vulnerable areas on account of its geographic location. Natural hazards like flood, flash flood, cyclone, storm surge, drought, river-bank erosion, landslide, etc., cause immense human casualty, crop failure and property loss almost every year, affecting the poor and low-income people. General public are very much affected and distressed on account of house collapse leading to troublesome accommodation problem in the wake of such disaster occurrence. Poverty and poor earning prevent average people from building and owning strong and well-built house, and this hard fact results in damage and destruction of their dwelling options following moderate wind and/or water in-flow.

Caritas Bangladesh identified this housing problem as far back as 1985 and has been on the move since then to find out practicable way out. It adopted a "Low-cost Housing" pilot project in 2010 following the 'evaluation of low-cost housing assistance' project undertaken earlier in 2007 to serve the families distressed by November 15, 2007 Cyclone SIDR. Low-cost houses were constructed during 2010 in cyclone-prone Kalapara upazila (sub-district) under Patuakhali district and flood-prone Sirajdi Khan upazila (sub-district) under Munshiganj district to provide relief to disaster affected families.

Eventually in 2012-14 following adequate experiment, study and observation, a pilot project titled Low Cost Housing (Pilot LCH) was taken in hand under financial assistance from Secours Catholique–Caritas France and Caritas Luxemburg. Prime aim and objective of the Project was evolving viable design and strategy towards construction of low-cost sustainable and disaster-friendly house according to hazard types in disaster-vulnerable areas of Bangladesh as well as to encourage and motivate the poor community at risk to accept and pursue them; Caritas utilized technical assistance in this respect from Bangladesh University of Engineering and Technology (BUET) and CRAterre France.

Mainstreaming Disaster Friendly Low Cost Housing (MDFLCH) project was subsequently undertaken for the period of 2016-18 under financial assistance from Secours Catholique – Caritas France. As part of the project, Caritas developed as many as 35 structural designs compatible to disaster-friendly and sustainable house construction in view of hazard types and hazard-risky area; BUET and CRAterre France provided necessary technical assistance in the exercise. To promote the issue further, 105 disaster-friendly and sustainable low-cost model houses were constructed according to these designs in 20 unions of 20 upazilas under 17 districts within 08 dioceses of Caritas Bangladesh.

Later, Disaster Management Committee members at union and ward level and Asrayon Task Force members within MDFLCH project area, project staff and BUET teachers visited the model houses time to time; they utilized these fact-finding visits to reflect on such relevant aspects as various designs, building pattern, local culture, easy availability of building materials in the locality, cost, etc.

Pertinent house-building aspects in consideration of threats and risks associated with flood, flash flood, cyclone and storm surge, river-bank erosion and drought vulnerable areas of Bangladesh were well discussed and duly analyzed at field, regional and national level to develop 'low-cost and sustainable house-building Instruction Manual' involving 10 construction steps. Workshops were organized at regional and national level in order to fine tune the issue and finalize 05 (five) low-cost house-building Guide Books to serve the purpose of the dwellers living in fore-noted five hazard-vulnerable areas.

Drought hazard is most common in Rajshahi and Rangpur divisions of Bangladesh. It results from scarcity of water and severe heat-wave; incidence of half or less than half amount of rainfall here compared to country's average does also precipitates dry spell and aridity in the area. Acute draught tells upon crop, results in unemployment of farmers and workers, leading in turn to wide spread lack of nutrition. Bangladesh experiences drought situation every five years by and large, people smarting in severe heat-wave in the process. Caritas undertook proper examination, monitoring and observation of the issue to find a way out towards a respite; result is this Manual that presents a drought-friendly house-model designed for the people living in arid and dry spell area. The same will prove worthy of, and comfortable to, the residents in drought prone area.

Disaster Management Sector of Caritas Bangladesh in cooperation with its eight Regional Offices had to put in extensive work and diligent effort to develop this Instruction Manual. Secours Catholique–Caritas France and Caritas Luxemburg provided financial assistance and Bangladesh University of Engineering and Technology (BUET) and CRAterre France offered technical assistance. We are sincerely grateful to all of them. We are equally grateful to International Federation of Red Cross and Red Crescent Societies (IFRCS) to allow us to utilize 16 (sixteen) of their suitable pictures for the Manual: (Cf. Session-1 Pics.5 & 9; Session-2 Pics.12 & 19; Session-4 Pic.50; Session-8 Pics.81, 82, 83, 84, 85, 86, 87, 88 & 89; and Session-9 Pics.90 & 91).

The Manual refers to the building materials compatible to hazard-risk reducing construction and prescribes the requisite strategy. We are convinced that proper training of the construction labour force as per the Manual, involvement of the people to its purpose and construction of hard and strong house in the disaster prone area in accordance with its guidelines will make for minimal damage and loss in disaster aftermath. We also firmly believe that this Manual will capacitate the poor community living in the drought risk vulnerable areas of Bangladesh to build low-cost, drought-friendly, sustainable as well as safe and comfortable house.

To conclude, changing and advanced technology and variation in hazard pattern will necessitate modification and re-edition of the Manual in view of time-to-time reflection and observation, and we will do the needful accordingly. Valuable advice and opinion of the Readers and Users of the Guide Book will be attached due importance during re-editing process.

Francis Atul Sarker
Executive Director
Caritas Bangladesh

Session I

Subject: House Layout
(First Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To explain formation of the Layout of a disaster-resilient house and actually form a layout. 2. To pin-point the area, type and set-up of the Layout and mention advantages and disadvantages thereof. 3. To describe the disaster risk reduction aspects while formulating the Layout and apprise others accordingly
Time	75 Minutes
Methodology	Lecture, Discussion, Question-Answer, Event recounting, Experience sharing, Picture display and Drawing.
Materials	Board, Poster Paper, Marker, Flip Chart, Scale, Tape, Rope, Thread, Bamboo Pillar, Hammer, Spade, etc.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will seek participants' view/opinion about layout, rationale behind layout, nature of layout in their locality, which points / issues are considered relevant to site selection during construction of a house. 2. Following participants response, s/he will expose them to issues for consideration in respect of house site selection through relevant picture(s) by way of flipchart/multi-media; s/he will also provide handout/sample picture(s) to them.
	Step-III:ime-25 Minutes Facilitator will take the participants in the field and impart practical lesson on layout setting.
	Step-IV:Time-10 Minutes Facilitator will point out to the participants what disaster risk reduction aspects need to be considered in setting the layout.
	Step-V:Time10 Minutes Facilitator will seek Participants perception of the following as part of evaluation process through question-answer: 1. What is a layout, how and where to draw it, its necessity, advantages and disadvantages, imperatives, etc.? 2. Which disaster risk reduction issues are relevant for consideration while drawing a layout. S/he might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; s/he then will wrap up the session with vote of thanks

(House Layout)

Layout of a house refers to its location/situational aspect and its construction formula. Appropriate layout in right position allows adequate light and wind ventilation in the house, makes for homestead beauty, minimizes storm wind pressure and ensures slender possibility of plinth collapse.

Following issues warrant due consideration to determine house layout:

Area: Total area of a house should measure 18'x10'-6" + 6' in view of SPHERE Standard and normal house-building calculation in rural Bangladesh. Such area is determined to consider and accommodate living space, provision of guest and family conference point, storage of household materials, personal privacy of women, girls, elderly persons and persons with disability, etc.

Location: South-faced main door of the house ensures adequate light and wind. Because of geographic location, Bangladesh features wind flow from south-western corner for better part of the year. On the other hand, wind flows here from north-east side during winter. As a result, sufficient light and wind are available in the house with comparatively cool atmosphere during summer, and conversely, house is quite warm and humid during winter.

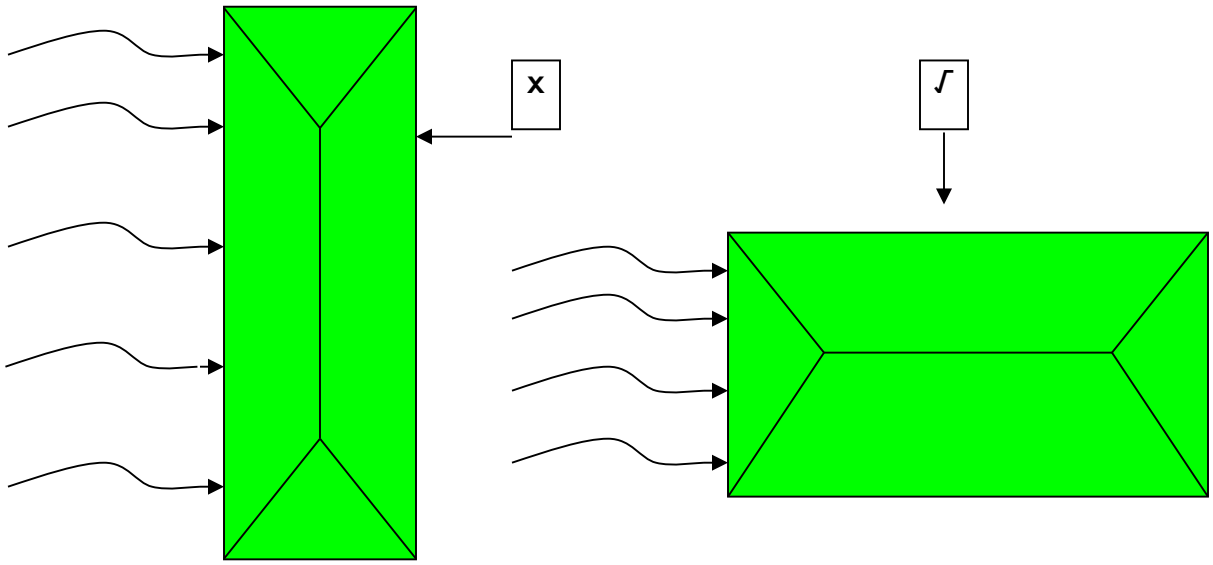
It is better and advisable to provide for kitchen, water source and latrine as close to the house as practicable for the safety of women, girls and children as well as for convenience of elderly and persons with disability. It should be ensured that water source point and latrine ought to be at least 30 feet apart; they can however be closely situated where sanitary latrine is provided with septic tank. .

There should be provision of proper sewerage and drainage for the sake of healthy and pollution-free atmosphere around the homestead.

Neighbours should be consulted while marking out the layout/precinct of the house to learn their advantages and disadvantages; this makes way for peaceful coexistence in the area.

Layout Cost: Estimated **BDT500.00** to **BDT1,000.00**

Pictures depicting issues/matters relevant to Layout drawing

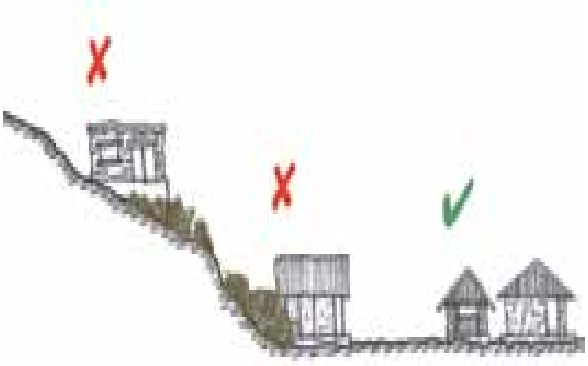


Proposed and Discouraged House Design

Picture 1: Breadth of the house should be in the direction of wind-flow advent/ingress so as to minimize the wind pressure and lessen the possibility of house blow-off

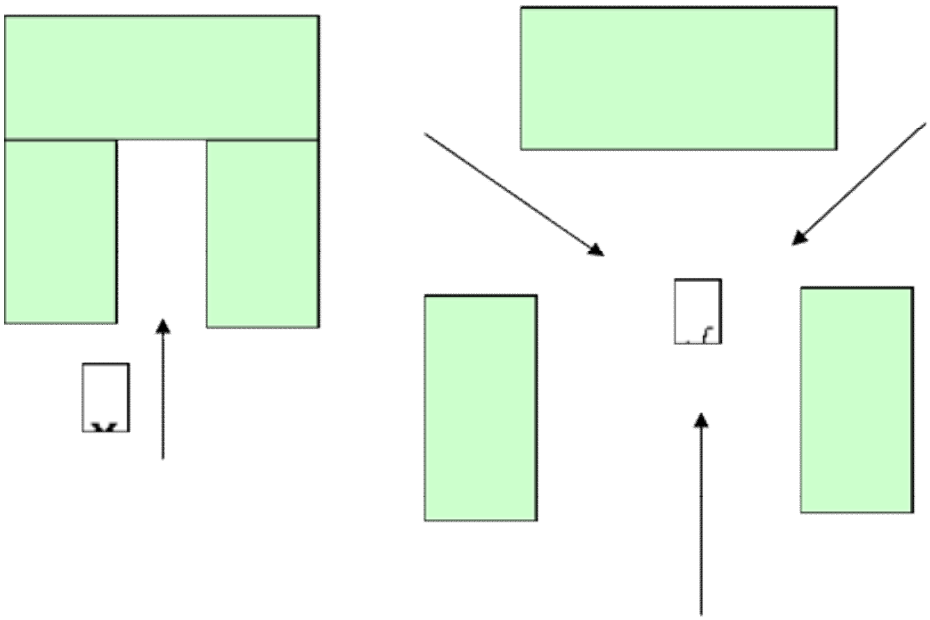
Pictures 2 and 3: Constructing house adjacent to pond or canal or river is very risky

Pictures depicting issues/matters relevant to Layout drawing



Pictures 4, 5 and 6: Constructing house in hill slope is very risky

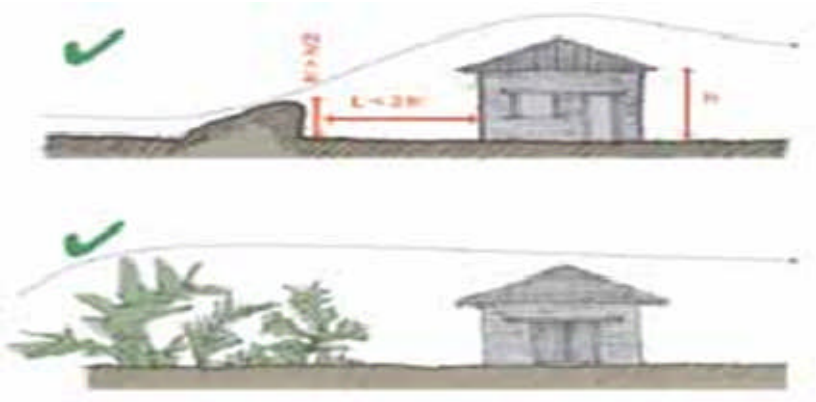
Pictures depicting issues/matters relevant to Layout drawing



Picture 7: Drawing Layout with provision of sufficient wind passage as above allows adequate wind and light inside and reduces air pressure

Picture 8: Provision of Latrine at 30 feet distance from the house in northern or western side keeps the house stink free

Pictures depicting issues/matters relevant to Layout drawing



Picture 9 Tree plantation at suitable distance in the vicinity of the house makes for minimum storm-wind slash leading to lesser risk of house collapse; tree plantation is imperative to withstand/contain wind slash (Sketch Credit : IFRC)

Picture 10: House construction in safe distance discounts the risk of house collapse through tree-falling

Picture 11: House construction in unsafe distance involves the risk of house collapse through tree-falling

Session II

Subject: Foundation of the House
(Second Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define various types of Foundation, foundation of low-cost disaster-resilient house as well as its importance. 2. To name necessary building materials and describe construction strategy in relation to various Foundation of low-cost disaster-resilient house. 3. To reflect on the relevant aspects of disaster risk reduction while engaging in house Foundation and inform others accordingly. 4. To assist others in working out the Foundation of low-cost disaster-resilient house according to noted design.
Time	75 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing, Picture/Model display and Drawing.
Materials	Foundation Model, Multi Media (if available), Module, Board, Poster/Brown Paper, Marker, Leaflet, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster/brown paper.
	Step-II:Time-30 Minutes 1. Facilitator will discuss sequentially about definition of foundation, various types of foundation, foundation of low-cost disaster-friendly house and its importance by way of picture/model display and/or drawing on board or brown paper in view of the handout. 2. S/he will narrate about foundation worked out through brick, RC stone, RC pillar, soil/clay, etc., and its implementation mode; s/he will later display model or picture of each foundation and hold discussion through question-answer. Foundation type in the locality and its implementation process should however gain priority in the discussion.
	Step-III:Time-20 Minutes Facilitator will refer to the benefit of foundation and explain the drawback of a weak foundation; s/he will then discuss about maintenance of foundation, construction timeframe and cost. He would ensure that the discussion is not one-way and that the participants can raise questions.
	Step-IV:Time-10 Minutes Facilitator will apprise the participants which matters/issues need to be considered to reduce disaster risk during foundation work; s/he will utilize handout and might display picture or model to that end.

Session Conduction Process (Contd.)	**Step-V:Time-10 Minutes** Facilitator will seek participants understanding about the following as part of evaluation process through question-answer: 1. What is foundation? 2. What materials are required during foundation work? 3. What are the benefits and drawbacks of foundation? 4. What issues deserve consideration to reduce disaster risk during foundation work? Facilitator might be required to reiterate point(s)/issues as he deems appropriate for the sake of participants clarity; s/he then will wrap up the session with vote of thanks.

Tip for the Facilitator

The Facilitator is required to consult various books, reports, updates, etc., relating to this topic apart from the module in order to gain clear concept of the subject matter; s/he might also try to collect any other relevant case-study to bolster his perception.

Facilitator's Guide

(House Foundation)

Foundation

Foundation is the base on which house is erected. Overall weight of a house is transformed underground through foundation. Foundation has to be on hard compact soil as per appropriate design/sketch/drawing; otherwise, weight of the house might subside house-soil underground leading to crack/rupture/breakage in wall, pillar or any portion of the housing gears. Foundation is thus considered as very essential part of the house.

Characteristic Detail

1. Breadth of a house is generally found to be large or small in consideration of the weight or load borne by wall and pillar.

2. Foundation depth generally differs in view of the height of the house, disaster perspective and local custom/practice.

3. Possibility of house tremor, leaning and blown-out due to storm can be overcome if pillar is dug at least 1'-6" feet deep inside the hard soil and T-shaped plate is set below the pillar.

4. Foundation is to be interwoven with required number of Anchors, otherwise wind might blow away wooden gears.

Construction Strategy

1. Foundation Base ought to be at hard compact soil layers.

2. There should not be any foundation work at artificially filled-in soil layers. Even if foundation base is worked out at artificially filled-in soil layers, it has to be strong and hard as per appropriate foundation design.

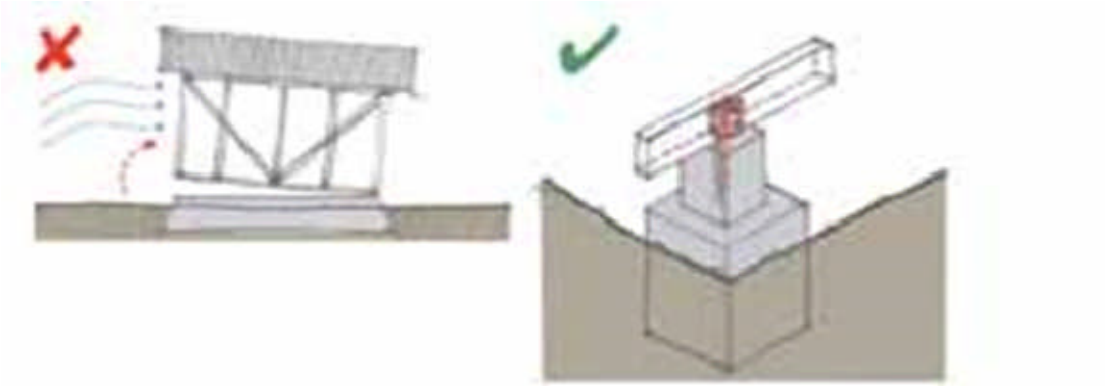
3. The pillar has to be dug at least 1'-6" feet deep inside the hard soil (through a Paddle used by Bangladesh Rural Electrification Board, if required); the hole is to be compacted with a blending of hard soil, sand, brick chips, stone chips, etc., to prevent pillar's movement.

4. Bottom portion of brick-wall and pillar foundation hole needs to be hardened through hammered pressure

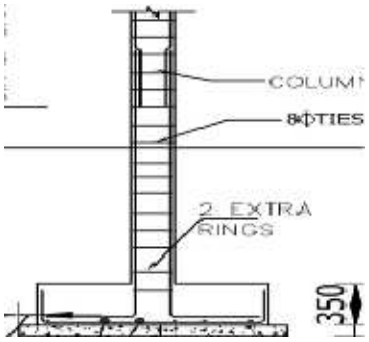
5. Foundation place has to be filled-in hard and hammered with compacted soil or sand after pillar setting.

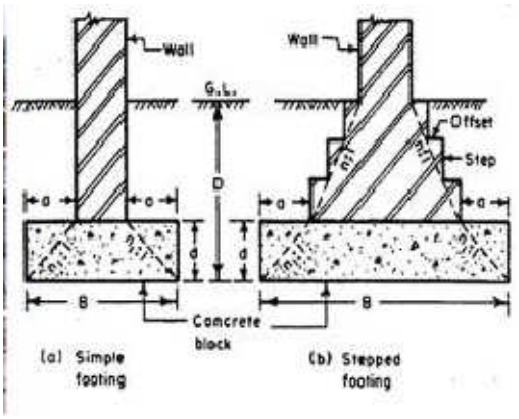
6. Provision of appropriate measure like drainage has to be there to prevent water accumulation at foundation base. .

Pictures depicting issues/matters relevant to Foundation Work

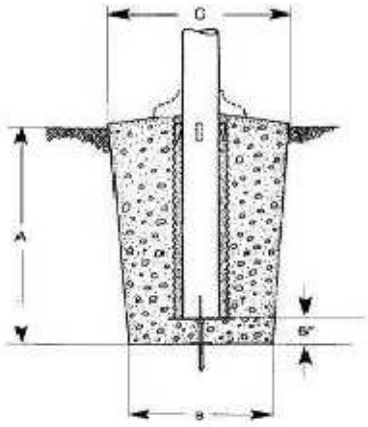


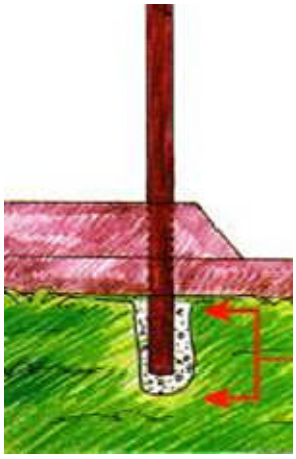
Picture 12: Required number of Anchors should accompany the foundation (Sketch Credit: IFRC)





Picture 13: RC Column foundation	Picture 14: Brick-work foundation





Picture 15: RC pillar foundation	Picture 16: Wooden pillar foundation

Advantages

House will not bend and wall will remain crack-free as long as hard soil layers will form its foundation with depth and width according to stipulated design.

Disadvantages

Accumulation of water at foundation base will slide it downwards causing wall-collapse and leading to life damage and property loss.

Maintenance

Corroded/washed out soil at the foundation base should regularly be replaced by quality soil, hard-pressed as well as smeared and polished.

Estimated Cost of Foundation (18' feet x10'-6" feet plus 6' feet width balcony)

Earthen Foundation

Sl. #	Work Item	Amount in BDT
1	Earth cutting, watering and hammering for compaction , involving 02 Labourers	800.00
	Grand Total	**800.00**

Bamboo/Wooden Pillar Foundation

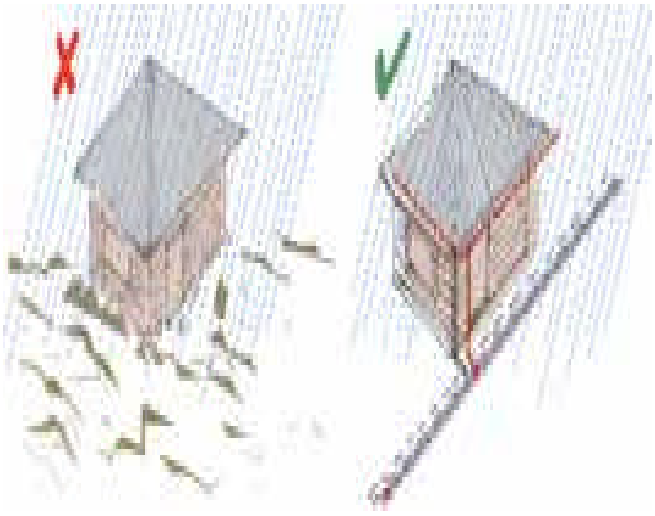
Sl. #	Work Item	Amount in BDT
1	Earth cutting, hole boring and hammering for compaction involving 02 Labourers	800.00
2	Mixture of brick chips and sand for strong foundation	1,200.00
	Grand Total	**2,000.00**

RC Pillar/Stone Pillar Foundation

Sl. #	Work Item	Amount in BDT
1	Earth cutting, hole boring and hammering for compaction involving 02 Labourers	630.00
2	Stone collection, stone-soil mixture	3,360.00
	Grand Total	**3,990.00**

Pictures depicting issues/matters relevant to Foundation Work

Picture 17: Specimen of a dug-out foundation



Pictures 18 & 19: Accumulation of water at foundation base causes soil erosion / corrosion weakening the house; provision of appropriate measure like drainage has to be there to prevent water accumulation at foundation base (Sketch Credit: IFRC)

Picture 20: Specimen of a suitable foundation

Session III

Subject: Plinth of the House
(Third Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define Plinth of the house and realize its importance. 2. To learn various types of house Plinth, their respective features, advantages and disadvantages. 3. To come across the strategy and process of constructing disaster-resilient Plinth. 4. To describe disaster risk reduction matters/issues while going for a Plinth and apprise others accordingly.
Time	75 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing, Picture/Model display and Drawing.
Materials	Foundation Picture/Model, Multi Media (if available), Module, Board, Poster/Brown Paper, Marker, Leaflet, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster/brown paper.
	Step-II:Time-30 Minutes 1. Facilitator will discuss about definition of plinth, various types of plinth, plinth of low-cost disaster-friendly house and its importance by way of picture/model display and/or drawing on board or brown paper in view of the handout. 2. S/he will display model or picture of each type of plinth and hold discussion on implementation of various types of plinth through question-answer; house plinth common in the locality and its implementation process should however gain priority in the discussion.
	Step-III:Time-20 Minutes Facilitator will refer to the benefit of plinth and explain the drawback of a weak plinth; s/he will then discuss about maintenance of plinth, construction deadline and cost. He would ensure that the discussion is not one-way and that the participants can raise questions
	Step-IV:Time-10 Minutes Facilitator will apprise the participants which matters/issues need to be considered in respect of disaster risk reduction during plinth work; s/he will utilize handout and might display picture or model to that end.

Session Conduction Process (Contd.)	**Step-V:Time-10 Minutes** Facilitator will seek participants perception of the following as part of evaluation process through question-answer 1. What materials are required to construct a plinth? 2. What are the various ways of its maintenance? 3. What issues matter in respect of disaster risk reduction while constructing a plinth? Facilitator might be required to reiterate points/issues as s/he deems appropriate for the sake of participants clarity; s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Plinth)

Plinth

Plinth is a very important and indispensable part of the house. The space between the courtyard level and floor of the house is plinth. Plinth might take various designs or forms depending on house type, disaster perspective in the area, local custom/practice, etc. For example, plinth formed by mixture of soil and other elements, brick-built plinth and stone-based plinth, etc. People in some area again are accustomed to bamboo or wooden platform as plinth as part of their custom/practice.

Characteristic Detail

1. Plinth type is determined by local custom/practice and availability of required materials in the area.

2. Length and breadth of the plinth measures at least 0.0'-0.6" feet larger than that of the house for the sake of sustainability.

3. Plinth height is determined in consideration of house location, hazard aspect and local custom/practice; in addition, its height is maintained at least 1 feet above the normal flood or water-logging level to stave off or reduce water submergence.

4. Mould of plinth soil is smeared / polished with one or the other of dry *binya* grass (a special type of grass), damaged paddy, dry straw, hardened grass, paddy husk, etc., depending on availability, in order to ensure strong and crack-resistant plinth.

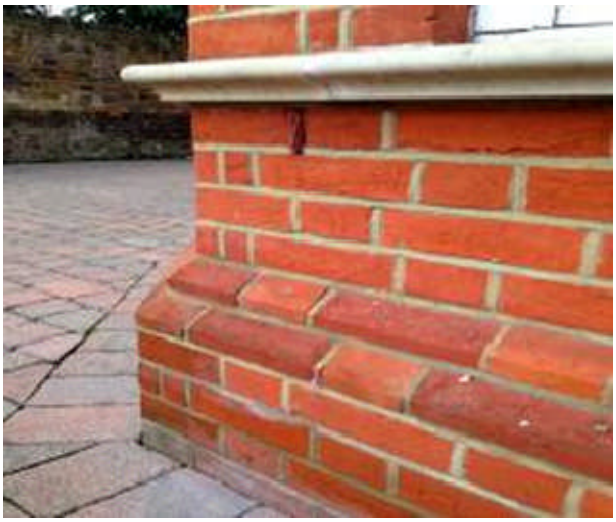
5. Plinth is made sloppy with provision of rungs to make it strong. Plinth height determines its slope and steps, generally 2-3 steps.

Pictures depicting various types of Plinth

Picture 21: Earthen plinth

Picture 22: Stone-based plinth

Picture 23: Brick-built plinth



Picture 24: Localized platform house

Earthen Plinth

Construction Strategy

1. Mould of plinth soil is smeared/polished with one or the other of dry *binya* grass (a special type of grass), damaged paddy, dry straw, stiff grass, paddy husk, etc., depending on availability, in order to ensure strong and crack-resistant plinth.

2. Preparing earthen mould along with ring-wall encircling the house and filling-in the floor space with appropriate soil has to be completed before finalizing the plinth. Earth filling upto 0.0'-0.6" feet layer along with hard-pressing of the soil is an effective deterrent to floor subsidence and fissure/crack.

3. Outer portion of the roof has to be so extended as rain-water pouring down the roof lands 0.0'-0.6" feet afar from the plinth, thereby preventing any damage to the plinth out of rain-water.

Time-frame

06 (six) Labourers would need to engage for 03 (three) days to complete earth-filling of 1'-6" feet height plinth and floor measuring 18'-0" in length x 10'-6" in breadth along with a balcony.
.

Advantages

1. Plinth strengthens overall structure of the house.

2. Required soil/clay forming the plinth along with mixing materials is locally available.

3. Landlord can equally engage in plinth work.

4. Application of any of (i) dry binya grass (ii) damaged paddy, (iii) dry straw, (iv) stiff grass, (v) paddy husk to plinth soil results in lesser fissure/crack in the plinth, reduced soil erosion as well as prevents damp/humidity and adds to sustainability.

5. Plinth structured with requisite steps is comparatively stronger than general plinth.

6. Plinth with attached steps is well-neigh immune to damage from rain-water; only the lower step might however be affected if and when circumstances turn unfavourable. Besides, rungs/steps can be repaired without much hassles at minimum cost when damage occurs; plus, overall management cost and labour charge are meagre.

Disadvantages

1. Green grass, raw straw, etc., tend to suck out earthen plinth, crack might result in the process; white ant might also be damaging.

2. Plinth is vulnerable to rat-hole.

Maintenance

1. Plinth has to be smeared/polished or treated with cow-dung at least once a month; frequency might vary according to locality.

2. Washed away and/or eroded and/or hole-affected areas of the plinth must be filled-in forthwith, to be followed by hard-pressing and smearing/polishing.

3. Vegetables, crop items, dry fish, etc., should not be stored/kept on the plinth floor to avoid any direct contact.

4. Rat menace must be addressed in no time.

Pictures depicting issues/matters relevant to Plinth

Picture 25: One Step is provided in the plinth where its height from the ground level equals one feet

Picture 26: One-and-a-half feet height from the ground to plinth level calls for two Steps

Picture 27: Where height from ground to plinth level is more than one-and-a-half feet, three Steps are warranted

Picture 28: One inch slope is generally provided in case of one feet height

Pictures depicting issues/matters relevant to Plinth

Pictures 29 and 30: If and when one or the other of dry *binya* grass (a special type of grass), damaged paddy, dry straw, stiff grass, paddy husk, etc., is smeared/polished with the mould of plinth soil, depending on availability, plinth gets strong and crack-resistant

Picture 31: Earthen mould has to be completed along with ring-wall encircling the house and the floor space has to be filled-in with appropriate soil before finalizing the plinth. Earth filling at 0.0'-0.6" feet layer with severe hammering of the soil proves to be an effective deterrent to floor subsidence and fissure/crack.	Picture 32: Additional portion of the roof has to be so extended as rain-water pouring down the roof lands 6" afar from the plinth, thereby preventing any damage to the plinth out of rain-water

Pictures depicting issues/matters relevant to Plinth

Picture 33: Use of green grass, raw straw, etc., tends to suck out earthen plinth, crack might result in the process; white ant might also be damaging.

Picture 34: Rats might bore holes inside the plinth.

Picture 35: Rain-water mark; plinth topsoil has been washed away. ,

Picture 36: Specimen of a cracked plinth.

Picture 37: Roof coverage should be at least 0.0'-0.6" feet beyond the house fence or wall area

Picture 38: Plinth has to be smeared / coated at least once a month; frequency might vary according to locality.

Brick-built Plinth

Brick-built plinths are common in water-logged, flood vulnerable and *haor* (wetland ecosystem) area of Bangladesh, because earthen plinths are unsafe and weak in the face of water in-flow. Besides, brick-built plinths are sustainable and protective against thieves, apart from adding to social status.

Characteristic Detail

1. Five-inch brick-built plinth is prepared for nine-inch high plinth

2. Ten-inch brick-built plinth is better to prepare nine-inch to two-feet high plinth; a combination of ten-inch and five-inch bricks' plinth may however be an alternative option in the light of the design in order to reduce cost.

3. Brick-built plinth utilizing a combine of ten-inch and fifteen-inch bricks may be used in case of two-three feet high plinth as per design.

4. In respect of plinth in *haor* / wetland area and saline water area, entire outer part of the brick-built plinth should be well plastered with net-cement finishing; which should go six inch underground .

Picture 39: Defective design results in crack in the plinth.

Picture 40: There can be brick-built plinth for a part of plinth area, vulnerable to rain-water sprinkles, avoiding the whole plinth area; This would minimize cost to some extent.

Pictures 41 & 42: Mud mixture can be applied to the plinth as a measure to minimize cost; but in that case, there has to be a pointing through blending cement with sand.

Construction Strategy

1. Brick-work will start with properly soaking first grade bricks. First grade bricks are not susceptible to breakage if dropped down from chaste-height position after setting them crosswise (lengthwise and diagonally) one above another. First grade bricks must be of copper colour and must be smooth and uneven.

2. Cement and sand will have to be suitably blended according to required proportion, later to be watered; resultant mixture must be put into use within one hour.

3. Thickness of foresaid mixture linking the bricks must not be less than 12mm and more than 20mm.

4. Masonry joint must be in the middle point of each brick; however joint would have to be one-fourth in respect of ten-inch brick-work.

5. Masonry must be effected as per appropriate plumb-line

6. Sand required in masonry has to be well strained so as to sieve out any unwanted and damaging particle.

7. Joints have to be well cleaned after work.

8. Saline water and salty sand must not be applied in mason-work and plaster.

9. Curing will follow for at least seven days following 24 (twenty-four) hours of masonry and plaster work.

Time-frame

06 (six) labourers have to engage for 04 (four) days to work out a brick plinth and fill-in the floor space with designed soil of a house measuring 18’ length x 10’ breadth x 8’ height.

Estimated Cost of a 8’ height Brick Plinth with Balcony

Work Item	Quantity	Unit Cost (BDT)	Total Amount BDT)
First Grade Brick	1,325 Ea	12.00	15,900.00
Sand	46 Cft.	30.00	1,380.00
Cement	5 Bags	500.00	2,500.00
Wages for a Mason and two Associates	Lump Sum		2,220.00
		Grand Total	**22,000.00**

Cost of a brick-built plinth can be minimized by having brick plinth only in the plinth side/ direction facing substantial rain-water sprinkles

Advantages

1. Brick-built plinth is generally hard and strong
2. It does not get damp
3. Strong and hard plinth lasts 20-25 years
4. Labour and management cost of the brick plinth is meagre or minimal
5. Plinth is immune to crack
6. Underground theft is not possible.
7. Brick plinth is not vulnerable to damage by rat

Disadvantages

1. Brick-built plinth is too much costly.
2. Excessive use of bricks results in environmental pollution.

Maintenance

1. Immediate repair of brick-built plinth in case of any damage.
2. Outer part of the plinth should be black-painted.
3. Immediate repair to make up soil erosion in the base. .

Comparative Cost of preparing a Plinth

Plinth Detail	Budget (BDT)
Earthen Plinth (1' lengthx10'-06"width=385cft)	4,500.00
Earthen Plinth with balcony (18' lengthx16'-06"width=545 Cft.	5,500.00
Mixture of *Binya* Grass, Husk, Dry Straw, plus Wages for 06 Labourers (BDT=400.00/Labourer)	2,400.00
Mixture of *Binya* Grass, Husk, Dry Straw (BDT=500.00), plus Wages for 06 Labourers (BDT400.00/Labourer)	2,900,00
Plinth prepared with Farrow Cement (complete with earth filling)	15,000,00
Brick-built Plinth (complete with earth filling)	22,000.00

Session IV

Subject: Pillar of the House
(Fourth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about different types of Pillar of the house and its importance. 2. To explain about construction strategy of different types of Pillar and their cost. 3. To narrate the advantages, disadvantages and maintenance of different types of Pillar. 4. To learn about low-cost disaster-resilient Pillars and inform others accordingly. 5. To explain the disaster risk reduction aspects/issues to be considered while constructing and installing a Pillar
Time	85 Minutes
Methodology	Lecture, Discussion, Question-Answer, Event/Experience sharing, Picture/Model display and Drawing.
Materials	Board, Poster Paper, Chalk/Marker, Picture, Model, Handout, etc.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster/brown paper.
	Step-II:Time-20 Minutes 1. Facilitator will gradually discuss about the pillar of the house through model and pictures (Pictures 1 & 3) in the light of the handout, like, importance of the pillar through lecture and question-answer, nature and importance of various types of pillars through model and picture display.
	Step-III:Time-25 Minutes 1. Facilitator will gradually explain the construction strategy and cost of the pillar, their advantages, disadvantages and maintenance; he would ensure that the discussion is not one-way and that the participants can raise questions 2. As to construction strategy and cost of the pillar, s/he will draw and write down accordingly on the board; if necessary, s/he will read out from the handout and utilize suitable model or picture 3. S/he will additionally explain about advantages, disadvantages and maintenance through picture display
	Step-IV:Time-15 Minutes Facilitator will apprise the **p**articipants which matters/issues need to be considered to reduce disaster risk during pillar construction and installation in the light of the handout.

Session Conduction Process (Contd.)	**Step-V:Time-15 Minutes** Facilitator will seek participants understanding about the following as part of evaluation process through question-answer 1. What is a pillar meant for? 2. What is its necessity and importance? 3. What about Its construction process and cost? Facilitator might be required to reiterate points/issues as s/he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Pillar

House roof in rural Bangladesh is usually set over wooden pillar or bamboo pillar or RC pillar or brick wall. Weight of the roof is transferred in this way onto the earth; a bonding between house-structure and earth is thus established, ensuring thereby the effectiveness of the house.

Scarcity of mature wood, insect/worm attack, pillar decay/decomposition at the base, cost, etc., substitutes RC pillar on the large scale for the wooden pillar

Picture 43: Termite-affected wooden pillar

Picture 44: Insect-affected wooden pillar triggered by earth contact

Picture 45: Use of RC pillar is on the rise in rural area

Characteristic Detail

- Length of the Pillar of the main house should generally be 10’ to 12’ feet and section – 5”x5” or 4”x4” inch
- Length of the Pillar in the balcony should generally be 9’ to 10’ feet and section – 4”x4” inch
- 04 (four) vertical 10 mm dia MS Rod; 08 mm dia Stirrup or Ring every 06 (six) inches (according to sketch/picture)

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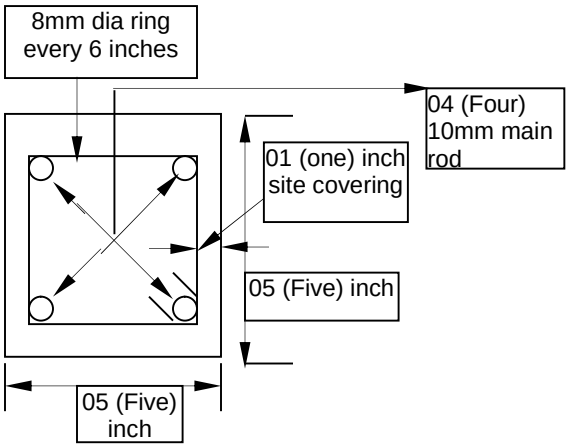
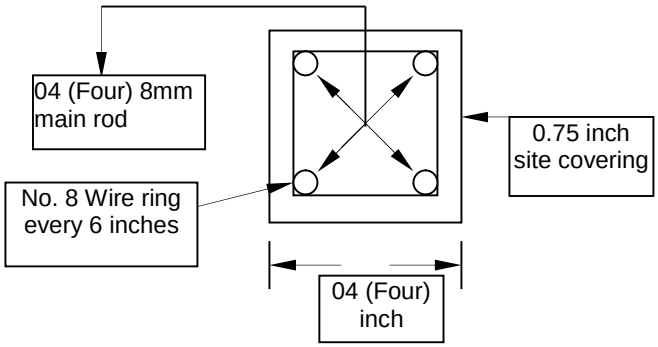
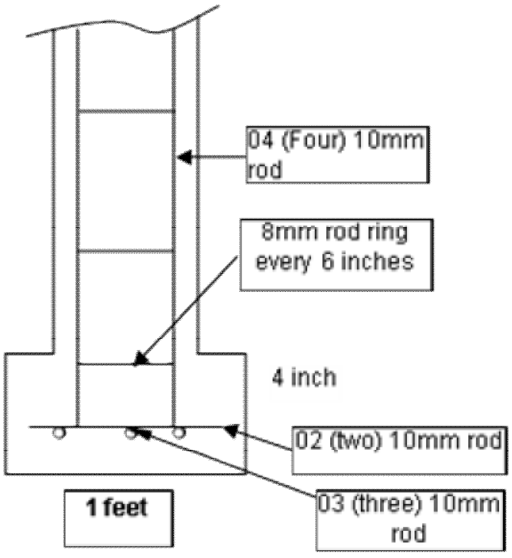


Graphics. 46: One RC Pillar section



Graphics. 47: One 04 (Four) inch RC Pillar section



Graphics. 48: One vertical column section

Construction Strategy

1. Cement, sand and stone-or-brick chips are to be blended at 1:2:4 ratio; to be mixed later with concrete applying proper quantity of water, so that the blended product does not get thin.
2. Half inch down-grade brick chips are to be applied.
3. Sand and brick- / stone-chips are to be properly filtered through a strainer.
4. Thick sand has to be properly filtered before use in casting so as to sieve out any iota of stone, dust or rubbish inside; as because, fine sand must be free from dust/rubbish.
5. Brick- and stone-chips must be well washed prior to blending.
6. The Pillar has to be dug at least 1'-6" feet inside the foundation/base (through a Spud/Paddle as utilized by Bangladesh Rural Electrification Board, if necessary). The hole has later to be compacted with hard soil, sand, brick-chips, stone-chips, etc., so as to avoid any movement of the pillar.
7. Pillar has to be dug vertically through plumb-line, so that it does not bend.
8. Pillar has to be perforated so as to properly ensure fence bonding, or attaching/setting door/window with sheath and corner bracing
9. Roof frame has to be strongly tied with RC pillar top using additional rod, nut, bolt, etc., to prevent the roof from being blown away by wind/storm surge.
10. Pillar mould/forma should well be watered or coated by heated mobil before casting
11. Pillar mould/forma should be removed 16 hours after casting
12. Pillar's edge must not be sharp
13. Sweet water, invariably not saline water; should be utilized for pillar casting and curing, and the water ought to be free from straw, grass or leaves
14. Curing should span at least over a period of 14 days
15. Structure of the rod has to be duly covered before casting/at the time of shuttering

Time-frame for preparing RC Pillar

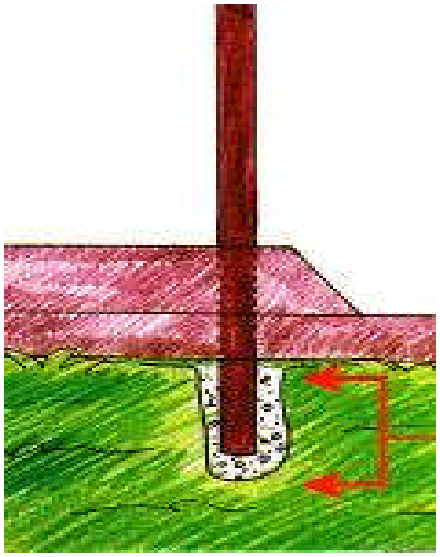
One mason in association with an associate can very well cast 04 to 05 pillars a day along with fastening rod and shuttering

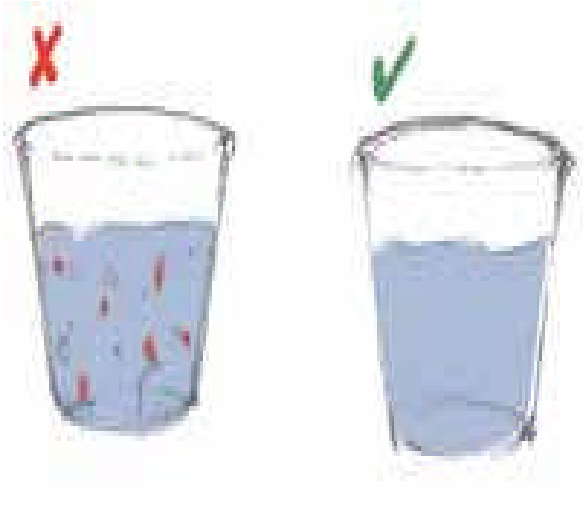
Cost

Item Detail	Quantity	Unit Cost (BDT)	Total Amount(BDT)
10' long Pillar of 5"x5" size	8 Ea	1,400.00	11,200.00
9' long Pillar of 5"x5" size for balcony	4 Ea	1,050.00	4,200.00
8' long Pillar made locally of octagon-corner stone, sand, cement and wire	8 Ea	420.00	3,360.00
9' long Pillar	4 Ea	315.00	1,260.00
		Grand Total	**20,020.00**

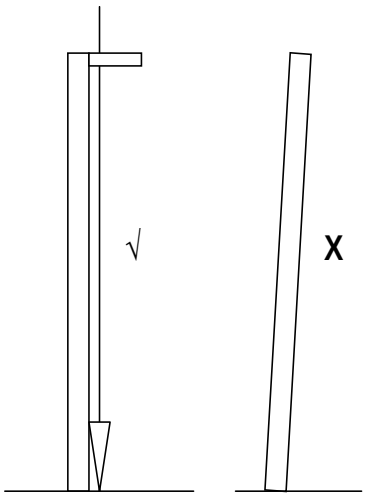
Note: Term "*Ea*" or "*Each*" is a standard unit for any countable item from materials management perspective

Pictures depicting issues/matters relevant to RC Pillar





Picture 49: The Pillar has to be dug at least 1'-6" feet inside the foundation/base. The hole has later to be compacted with hard soil, sand, brick-chips, stone-chips, etc., so as to avoid any movement of the pillar.	Picture 50: Drinkable water is to be used while casting pillar. (Sketch Credit-IFRC)



Picture 51: Pillar has to be dug vertically through plumb-line, so that it does not bend	Picture 52: Pillar has to be perforated so as to properly ensure fence bonding, or attaching/setting door/window with sheath and corner bracing

Pictures depicting issues/matters relevant to RC Pillar

Pictures 53 & 54: Roof frame has to be strongly tied by nut-and-bolt with RC pillar top providing for additional rod, so as to prevent the roof from being blown away by wind/storm surge

Picture 55: Cement, sand and stone-or-brick chips are to be blended at 1:2:4 ratio; to produce a RC pillar

Advantages

1. RC Pillar is stronger than, and can withstand/absorb more wind pressure in comparison to, bamboo/wooden pillar
2. It can last for 15-20 years if properly prepared
3. Its repairing is hardly required
4. It is less costly compared to mature wood
5. Requisite construction materials are locally available

Disadvantages

1. RC Pillar might develop crack and succumb to salinity, if its covering is not properly prepared

2. Its transportation might be problematic because of its weight as compared to the pillar made of bamboo/wood
3. RC pillar cannot be elongated in future
4. Its fitting and fixing with house roof, bracing and fence are tough and difficult in comparison to wooden pillar

Pictures depicting issues/matters relevant to RC Pillar

Picture 56: RC pillar might develop crack, succumb to salinity and get damaged, if its covering is not appropriate

Picture 57: Painting of RC pillar at the base ensures its immunity against saline water

Picture 58: Its transportation might be problematic because of excessive weight

Bamboo Pillar
(*Borak*-local variety)

Product of Bangladesh, availability of local materials and involvement of minimum cost dictate maximum use of mature bamboo pillar to construct earthen house in average rural area of the country.

Characteristic Detail

1. House pillar is generally 9 to 12 feet long with 3 to 4 inch dia
2. At least 3-year old mature bamboo is used to avoid worm-attack; yellow colour at the bamboo joints confirms its 3-year maturity
3. Borak / Baijjya / Vailka bamboo (local variety) is utilized as house pillar

Construction Strategy

1. At least 3-year old straight mature bamboo is utilized as house pillar
2. Bamboo meant for making pillar should be gathered from bamboo garden during Bangla months of *Falgun* and *Choitra* (corresponding to mid-February to mid-April) of the year; mature bamboo ought to be cut off from the garden before appearance of new leaves
3. Pillar has to be dug at least 1'-6" feet deep inside the indigenous/original earth
4. The hole has to be well compacted following insertion of the pillar
5. The pillar has to be dug vertically to prevent any tendency to lean down
6. There has to be a groove atop the pillar so as to well fasten the pyre; groove/sheath is to be carved slightly above the pillar-joint
7. Bamboo for pillar has to be dried up for 07 (seven) days following collection from the source. It has to be drenched under pond/canal/river water at least for 03 (three) weeks and later dried again for seven days before ultimate use. Seven-day dried pillars are long-lasting and immune to worm-attack; This process is termed 'seasoning' or locally branded as pannet / painally
8. Pillar can be alternatively soaked in dug/underground water in case there is no pond, canal or river nearby
9. Bottom part of the pillar plus six inches above the ground should be anointed/smeared with tar, thereby making it immune to worm-attack
10. Similarly, its immunity to worm-attack can also be ensured if the bottom part of the pillar plus six inches above the ground is made brown through baking in fire
11. Pillar base should be a little below its joint
12. Bamboo pillar lasts 10-15 years, if it is set over wood-wedge
13. Nails should be penetrated into bamboo pillar with the help of awl; otherwise bamboo might develop crack/fissure if done by hammer,

Cost

Estimated cost of a pillar measuring 9 to 12 feet long and 3 to 4 inch dia would be BDT=200.00; accordingly, at least 16 pillars (set every three feet) to cover a house measuring 18' feet long and 10' feet wide would cost BDT 3,200.00. 04 pillars in balcony would involve an amount of BDT 620.00, plus, 20 wood-wedges for the house and the balcony would cost BDT 6,000.00. Total cost would thus stand at **BDT 9,820.00**

Picture 59: Specimen of seasoning	Picture 60: Specimen of tar mixture

Picture 61: Specimen of wood-wedge	Picture 62: Mature bamboo

Advantages

1. Bamboo pillar is available almost everywhere in Bangladesh
2. It is less costly
3. House owner can prepare bamboo pillar all by himself
4. Mature and seasoned bamboo lasts 4-5 years
5. Bamboo pillar lasts 10-15 years, if it is set atop wood-wedge
6. Better part of the bamboo can be used afresh

Disadvantages

1. Pillar succumbs to worm-attack if mature bamboo is not available or the same is not seasoned
2. Underground part of the bamboo gets decayed/decomposed fast

Maintenance

Maintenance is hardly required; it is however advisable to ensure that pillar is in rare contact with soil and water

Wooden Pillar

Product of Bangladesh, local materials, custom/practice, affordability, etc., dictate common use of wooden pillar to construct earthen house in the country. Use of wooden pillar is however comparatively extensive in the hilly area.

Detail Characteristic

Pillar of the house generally measures 9' to 12' feet long with 4" x 4' inch Dia. Dia may be in-between 3"-5" inch in case of round shaped pillar. Length and size of the balcony pillar is shorter in view of the height of the house.

Construction Strategy

1. Mature wood should form a wooden pillar.

2. The Pillar has to be inserted at least 1'-6" feet inside the solid/hard ground (through a Spud/Paddle generally used by Bangladesh Electrification Board, if necessary). The dug-hole has later to be compacted with hard clay, sand, brick-chips, stone-chips, etc. so as to negate any movement of the pillar.

3. Pillar has to be dug vertically through plumb-line, so that it does not bend.

4. Groove/sheath has to be carved atop the pillar so as to well fasten the roof/pyre to the pillar

5. Pillar wood has to be immersed under water at least for three weeks, to be dried up next for seven days prior to use; this will keep pillar immune to worm-attack and at the same time enhance its longevity

6. Wooden pillar lasts 20-25 years, if it is set over wood-wedge

7. Pillar remains immune to worm-attack if underground part of the pillar plus six inches above the ground is made brown through baking in fire

Cost

One wooden pillar measuring 9-12 feet long with 2-3 inch dia would cost BDT-800.00; accordingly, a total of 08 pillars required for a house measuring 18' feet long and 09' feet wide would cost BDT 12,800.00, cost of 04 (four) 7' feet long pillars for balcony would be BDT 2,240.00, and BDT 3,000.00 would be incurred for 12 wood-wedges required for the house and balcony; Total cost would thus stand here at **BDT18,040.00. (Taka Eighteen Thousand and Forty).**

Advantages

1. Mature and seasoned wooden pillar lasts at least 10-12 years

2. Wooden pillar lasts 20-25 years, if it is planted over wood-wedge

3. Despite damage in the lower part, better portion of the pillar can be recycled

4. Expansion of the house and pillar repair is simple

Disadvantages

1. Expenses on account of wooden pillar is comparatively higher
2. Un-seasoned and immature wood is susceptible to worm-attack
3. Underground portion of the pillar tends to decompose/decay fast

Maintenance

Maintenance is hardly required; it is however advisable to ensure that pillar is in rare contact with soil and water

Comparative Cost Analysis of Bamboo Pillar, Wooden Pillar and Bamboo-cum-RC Pillar

Bamboo Pillar

Bamboo Pillar Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Bamboo Pillar for the main Dwelling (11'x4")	16 Ea	200.00	3,200.00
Bamboo Pillar for Balcony (7'x4")	04 Ea	155.00	620.00
Wood-wedge for Dwelling (2.5' Long and 4"x4")	16 Ea	250.00	4,000.00
Wood-wedge for Balcony (2.5' Long and 4"x4")	04 Ea	250.00	1,000.00
		Grand Total	**8,820**

Wooden Pillar
(hardly applicable to Varendra area in country's north-west because of wood scarcity there)

Wooden Pillar Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wooden Pillar for the main Dwelling (10'x4"x4") or Round Pillar from mature wood (3"-5" dia)	08 Ea	800.00	6,400.00
Wooden Pillar for Balcony (7'x4"x4") or Round Pillar from mature wood (3"-5" dia)	04 Ea	560.00	2,240.00
Wood-wedge for Dwelling (2.5' Long and 4"x4")	08 Ea	250.00	2,000.00
Wood-wedge for Balcony (2.5' Long and 4"x4")	04 Ea	250.00	1,000.00
		Grand Total	**11,640.00**

Bamboo-cum-RC Pillar (procured through own source/management)

Bamboo-cum-RC Pillar Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
RC Pillar for the main Dwelling (12'x5"x5")	08 Ea	1,400.00	11,200.00
Bamboo Pillar for the main Dwelling (11'x4")	10 Ea	200.00	2,000.00
RC Pillar for Balcony (9'x5"x5")	04 Ea	1,050.00	4,200.00
		Grand Total	**17,400.00**

Bamboo-cum-RC Pillar (procured from local market)

Bamboo-cum-RC Pillar Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Octagonal RC Pillar for the main Dwelling, 12' long, made from a blend of stone, sand and cement and tied with wire	08 Ea	420.00	3,360.00
Bamboo Pillar for the main Dwelling (11'x3")	10 Ea	200	2,000.00
RC Pillar for Balcony (9'x5"x5")	04 Ea	315.00	1,260.00
		Grand Total	**6,620.00**

Session V

Subject: House Fencing
(Fifth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about different types of Fence 2. To distinguish and explain between CI Sheet Fencing and Bamboo Fencing as well as their respective advantages and disadvantage . 3. To describe the technology to be applied and materials to be utilized for sustainable but low-cost CI Sheet Fencing and Bamboo Fencing 4. To explain the disaster risk reduction aspects/issues to be considered in respect of CI Sheet Fencing and Bamboo Fencing and inform others accordingly 5. To reflect on the strategy to care and maintain CI Sheet Fencing and Bamboo Fencing
Time	70 Minutes
Methodology	Lecture, Discussion, Group Discussion, Question-Answer, , Picture/Sample/Model display
Materials	Multi-Media (if available), Fence Specimen/Model, Board, Poster Paper, Marker, Pen & Writing Book, Handout, etc.
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will discuss about the fence, its necessity and importance 2. S/he will reflect on the various types of fence common in different places with the help of multi-media, model/picture display, etc. 3. S/he will undertake discussion through question-answer about fence making strategy common in a particular area 4. S/he will involve the participants in discussion on respective advantages and disadvantages of CI sheet fencing and bamboo fencing .

Session Conduction Process (Contd.)	**Step-III:Time-20 Minutes** 1. Facilitator will undertake discussion through question-answer on the construction strategy of earthen wall prevalent in the area 2. Following the update on the problems around fencing, s/he will share with the participants the reasons behind the identified problems and ways to solution thereof 3. S/he will later reflect on, and share with them about, disaster-friendly strategy available from the Caritas-implemented pilot project with the help of multi-media, picture/model display, etc
	Step-IV:Time-10 Minutes Facilitator will apprise the participants in the light of handout or with the display of picture/model which aspects/issues need to be considered to reduce disaster risk around fencing
	Step-V:Time-10 Minutes Facilitator will seek participants perception of the following as part of evaluation process through question-answer 1. What is a disaster-friendly house? What are the advantages and disadvantages of the fence around such a house? 2. What kinds of sustainable technology are applicable to preparing a fence in the area? 3. What materials/ingredients are indispensable to ensure a more sustainable fence? 4. What matters/issues are relevant for consideration towards framing a house fence supportive to disaster risk reduction? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Wall/Fence

Wall/Fence covers the house from all sides as well as the area in-between the floor and the ceiling. Wall or fence of a house ensures safety and privacy of the life and property of the insiders as its prime role. We come across various types of wall and fence based on custom/practice in the area and materials/ingredients available there; like, bamboo fence, CI Sheet fence, tin-cum-bamboo fence, wooden fence, jute stick fence, fence prepared from *Ekor* (a local variety of sung-grass),fence made out of straw, fence utilizing *Taty* (a country variety), earthen wall, brick wall, etc. A house is sometime subdivided in the form of rooms through partition wall or fencing partition.

Earthen wall is very common in those regions of Bangladesh that are free from flood and storm surge havoc and where heat-wave and cold-wave are severe. Wall built with soil / clay was very popular with the people in the past; but, with the expansion of flood and storm surge vulnerable area in the country following climate change syndrome, construction of earthen wall house is declining fast.

Earthen Wall

Characteristic Detail

1. Width or span of an earthen wall is considered and finalized on the basis of area site, prevailing heat in the location, local custom/practice, house measurement, height of the house, soil/clay variety, etc.
2. Earthen wall is built with earth mound/clayed ordure or soil block
3. One or the other of dry *binya* grass (a special type of grass), stiff grass, dry straw, paddy husk, damaged paddy, etc., is smeared/polished with soil/clay to form earth mound towards getting a hard/stout as well as crack-resistant earthen wall
4. Two to three rows of bamboo splits every other rung/step (at the height of 9") ought to be horizontally placed within the earthen wall as a measure to strengthen the wall and enhance its potential to confront and defy earthquake onslaught

Construction Strategy

1. Required volume of soil/clay has to be dipped into water for 05-07 days and to be utilized later to prepare earth mound; afterwards, these mounds would have to be so smeared/pressed by human legs and/or cow or buffalo that the resultant product no longer contains any chunk or lump whatsoever.
2. If and when leg sticks to the mound as we dip our leg into it, we would find the proper/workable mound to work with; otherwise there would be no mound as such if our leg(s) feel flexible in it as soon as we touch the same for due observation.
3. Later, one or the other of dry *binya* grass (a special type of grass), stiff grass, dry straw, paddy husk, damaged paddy, etc., is to be suitably smeared / blended with this to result in expected mound to be treated as a necessary constituent/ingredient in making the wall for house construction.
4. Three rows of bamboo splits diagonally placed within the earthen wall at the height between 9" inch to 1' feet have to be utilized every other rung/step
5. Work on the next stage of the wall so prepared would have to start after drying of the above for two/three days
6. The lump of the mound has to be flung hard in-between the two layers while creating the new layer over the first, so as to effect a strong bonding between the two
7. One to two offsets (at least 2") and slopes (2" for every 10' height) has to be provided for outside the earthen wall; generally, there is 1 (one) step/rung for one floor and 2 (two) steps/rungs for two floors outside the wall. This reduces the weight of the upper part of the wall, and it can be repaired despite damage from rain-water if the base is coarse/thick.
8. Extended porch is provided for Kutcha/Earthen house and wooden borunga is well applied to hold on to the house structure
9. Wood pieces / bamboo splits have to be used below the tie-beam/shaft
10. Wood/bamboo needs to be employed as lintel on the upper part of door/window frame, so that the latter can bear the weight of the upper (part) of the wall
11. Tie-beam has to be extended 06 (six) inches beyond the wall, so that there can be a tightened pull involving the roof
12. It is advisable to employ earthen block below the payeer atop the wall as a measure to spread out the overall weight of the roof on the earthen wall
13. The wall can be made hard and strong through cudgel-hammering

Advantages

1. Earthen wall keeps the house cool in summer and warmer during winter
2. Construction materials/requisite ingredients of earthen wall are locally available, skilled workers are there and family members do also engage in work
3. Possibility of fire is remote as because earthen wall is by nature fire-resistant

4. Use/application of dry *binya* grass (a special type of grass), stiff grass, dry straw, paddy husk, damaged paddy, etc., keeps the wall hard and strong as well as soil erosion and crack/fissure free. Eventually, the wall lasts for a longer period and involves minimum maintenance and management cost
5. Use/application of bamboo splits within the earthen wall strengthens the wall and enhances its potential to confront and defy earthquake onslaught

Disadvantages

1. Rat hole might damage the wall
2. It might subside/succumb to earthquake and/or flood

Maintenance

1. Smearing / plastering the wall with a mix of soil/clay and cow-dung
2. Regular plastering the washed out/eroded points of the wall with clay mound to cover the created cavities/gaps
3. Vegetables, dry fish, etc., must mot be kept/stored directly on the floor to stave off rate menace

Time-frame

Three labourers need to work for 16 (sixteen) days to complete an earthen wall measuring 18' feet long, 10' feet wide and 1'-6" feet thick; November to April is the suitable/ideal timing to work on earthen wall

Cost

Item Detail	Quantity	Unit Cost (BDT)	Total Amount (BDT)
Completion of an earthen wall measuring 18 feet long, 10 feet wide and 1'-6" feet thick	03 labourers/ 16 days	400.00	19,200.00
		Grand Total	**19,200.00**

(Involvement of family members in the work might minimize the expenditure)

Partition

Partition is the separation of two rooms of a house through wall or fence. Partition safeguards security, provides space for children's education and proves effective from gender perspective.

Earthen wall, brick wall, bamboo fence, CI Sheet fence, wooden fence, jute stick fence, *Ekore* fence, *Tati* fence, straw fence, etc., are utilized to form partition.

Pictures depicting issues/matters relevant to preparing Fence

Pictures 63 & 64: Use/application of any one of dry *binya* grass (a special type of grass), stiff grass, dry straw, paddy husk, damaged paddy, etc., to the mound to construct wall keeps it hard and strong as well as soil erosion and crack free.

Picture 65: Use/application of bamboo splits within the earthen wall strengthens the earthen wall and enhances its potential to confront and defy earthquake onslaught	Picture 66: Wood pieces / bamboo splits have to be used below the tie-beam/shaft to make the wall crack-free

Pictures depicting issues/matters relevant to preparing Fence

Pictures 67 & 68: One or two Steps (at least 2”) are provided outside the earthen wall as a measure to reduce the weight of the upper part of the wall to make it stronger and also for smooth maintenance

Pictures 69 & 70: Roof is safe against wind-slash if it is attached to the extended part of the tie-beam

Pictures depicting issues/matters relevant to preparing Fence

Pictures 71 & 72: Use/application of earthen block below the payeer atop the wall to spread out the overall weight of the roof on the earthen wall keeps the wall crack-free

Picture 73: In a house built on earthen wall, temperature reads 2-3 degree Celsius less in summer and increases by 4-5 degree during winter	Picture 74: Hammering by a cudgel makes a wall hard and strong

Pictures depicting issues/matters relevant to preparing Fence



Pictures 75, 76 & 77: Earthen wall can be beautified by sketch/design curved out by soil/clay

Picture 78: Small pockets/cells can be provided for on the earthen wall to place and store minor household items like cosmetics

Comparative Cost Analysis of House Wall and Fence prepared with various ingredients

House Fence from Bamboo and CI Sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Bamboo Mat	168 Cft.	20.00	3,360.00
CI Sheet–0.23 mm/8 Ft.	13 Ea	400.00	5,200.00
Wood (1.50”x1.00”)	1.50	1,000.00	1,500.00
Masonry Charge	1	1,000.00	1,000.00
		Grand Total	**11,060.00**

House Fence from CI Sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
CI Sheet–0.23 mm/8 Ft.	26 Ea	400.00	10,400.00
Wood (1.50”x1.00”)	3 Cft.	1,000.00	3,000.00
Masonry Charge	1	1,000.00	1,000.00
		Grand Total	**14,400.00**

Earthen Wall

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Completion of an earthen wall measuring 18’ feet long, 10’ feet wide and 6” thick	03 labourers/ 16 days	400.00	19,200.00
		Grand Total	**19,200.00**

House Fence from Earthen Wall and CI Sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Brick, etc., Volume	140 Cft.	100.00	14,000.00
CI Sheet–0.23 mm/8 Ft.	13 EA	400.00	5,200.00
Wood (1.50”x1.00”)	1.50	1,000.00	1,500.00
Masonry Charge	1	1,000.00	1,000.00
		Grand Total	**21,700.00**

Session VI

Subject: Doors and Windows
(Sixth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about the importance of Doors and Windows 2. To narrate about site selection and preparation mode of Doors and Windows . 3. To describe about advantages, disadvantages and cost involving Doors and Windows 4. To explain the disaster risk reduction aspects/issues to be considered in respect of Doors and Windows and inform others accordingly 5. To describe how to maintain Doors and Windows
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Experience sharing and Picture/Sample/Model display of doors and windows
Materials	Marker, Masking Tape, Pin, Brown Paper, Specimen/Picture of doors and windows, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will discuss about the doors and windows and their necessity 2. S/he will reflect on various types of doors and windows and their importance 3. S/he will discuss about door and window making technique, their utility and cost.
	Step-III:Time-15 Minutes S/he will reflect on disaster risk reduction strategy in respect of doors and windows and explain with the help of picture
	Step-IV:Time-10 Minutes Facilitator will seek participants understanding about the following as part of evaluation process through question-answer 1. What are the importance, advantages and disadvantages of the doors and windows? 2. What needs to be done to reduce disaster risk relating to doors and windows? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Door

Door is required to enter in the house, facilitate adequate wind and light inside as well as ensure security and privacy of all. Local custom/practice and availability of materials/ingredients determine the type, nature and shape of the door. Door consists of a door-frame and a door-shutter. Wooden door is common in average rural area of Bangladesh; Steel doors are also being used now-a-days. Each house should have at least two doors.

Window

Window is indispensable to facilitate adequate wind and light inside. Iron grills and sticks are set in the window to prevent anybody from entering inside and obstruct any theft; window-shutters are there to ensure privacy and protect against air, sunlight and rain water. Local custom/practice and availability of materials/ingredients determine the type, nature and shape of the window. Wooden window is however common in average rural area. It is advisable to have at least two windows in a room to facilitate adequate and regular passage of air and light.

Picture 79: One window needs to be placed opposite to another so as to facilitate adequate wind-flow

Characteristic Detail

1. Generally, one door is set in the front of the house and another in the rear or at the side; again, a connecting door is in place for the adjacent room.
2. Door height is generally 6' to 7' feet and its breadth varies between 2'-6" feet to 3' feet.
3. Cross-section of the door-frame assumes various measurement: 2"x2" inch, 2"x 3" inch and 2.5"x3" inch.
4. Thickness of door-shutter is generally 1"x1.5" inch.

5. Z batten or panel door is used.
6. 3”-5” inch size hinges and 4”-6” inch size hook/shackles/ring are set in the door for its opening and closing
7. One- or two-part door and window are used as per custom/practice in the area; people are accustomed to four-part window, too.
8. Window height is generally 3’-4’ (three to four) feet and breadth 2’-6” to 4’ feet or more; window is set 2’-6” to 3’ feet above the plinth level
9. Cross-section of window-frame assumes various sizes: 2”x1.5” inch in case of bamboo fence and 2”x2.5” inch or 2.5”x3” inch in case of earthen wall. Thickness of window-shutter is generally 1”-1.50” inch
10. 3” inch size hinges and 4” inch size hook are used in the window. In addition, shackles/ring/wooden fastener/cramp is also used
11. Wood variety to be used for doors and windows depends on local availability. It must however be *Sari Kath* - local term, implying wood of better substance/kernel and/or quality wood.

Construction Strategy

1. Seasoned timber of mature tree has to be used as per local custom/practice
2. Doors and windows framed by seasoned timber last almost five times more
3. Doors and windows are treated with enamel paint for beautification and sustainability as well as to counter insect-attack and damage from water. Anointing with brownish oil at minimum cost adds to sustainability, too
4. Door- and window-shutters should be set inside the house
5. One window needs to be placed opposite to another so as to facilitate adequate wind-flow
6. Additionally, windows location/setting should be so as to accommodate convenience of the neighbours

Time-frame and Cost

Four days might be required to prepare and set two doors and four windows in a house measuring 18’ (eighteen) feet long and 10’ (ten) feet wide; total cost would come to **BDT18,000.00** (Taka Eighteen Thousand) only: BDT10,000.00 for doors and BDT 8,000.00 for windows.

Advantages

1. Adequate light and wind are available in the house and healthy environment prevails
2. Security of life and property as well as dwellers privacy is ensured
3. Closure of door and window shutters during winter ensures little cold
4. Doors and windows prevent water surge inside the house during rain and storm

Disadvantages

1. Doors and windows might be vulnerable to wood-louse attack

1. Expansion and contraction of door-shutters and window-shutters during winter and summer might deform the shutters affecting smooth opening and closure thereof

Maintenance

1. Time to time application of kerosene or turpentine oil to door and window frames and shutters might prevent wood-louse attack
2. Prompt repair of any danaged part of the window is advisable

Comparative Cost Analysis of House Doors and Windows prepared with various constituent ingredients

Door and Window made of Wood

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Door 2.50'x6.50' *Mehagony wood, thickness of door-shutter 1", door-frame 3"x2.50"	02 Ea	3,500.00	7,000.00
Window with Grill 3'x2.50' *Mehagony wood, thickness of window-shutter 0.75", window-frame 2"x2"	04 Ea	2,000.00	8,000.00
		Grand Total	**15,000.00**

***Valuable **t**ree available in the area offering good quality timber

Door and Window made of Steel

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Door 2.50'x6.50' MS Steel thickness of door-shutter 22 Gauge, door-frame 1.50"x1.50" with MS Angle 3mm	02 Ea	5,000.00	10,000.00
Window with Grill 3'x2.50' MS Steel thickness of window-shutter 22 Gauge, window-frame 0.75"x0.75", thickness of MS Angle 2mm	04 Ea	2,000.00	8,000.00
		Grand Total	**18,000.00**

Door and Window made of CI Sheet and Wooden Frame

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Door 2.5'x6.5', Tin door-shutter and wooden door-frame	02 Ea	1,650.00	3,300.00
Window 3'x2.50' CI Sheet window-shutter and wooden window-frame	04 Ea	800.00	3,200.00
		Grand Total	**6,500.00**

Session VII

Subject: House Truss and Shed
(Seventh Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about house Truss and Shed and their construction strategy 2. To narrate in sequence about the type and measurement of wood to prepare Truss and Shed . 3. To learn and describe about cost, maintenance and sustainability of easily and locally available wood 4. To explain the disaster risk reduction aspects/issues to be considered while preparing Truss and Shed and inform others accordingly
Time	70 Minutes
Methodology	Lecture, Discussion, Question-Answer, Group Discussion and Picture/Sample/Model display
Materials	Board, Multi-media, Handout, Poster Paper, Marker, Pen-Writing Pad, Cork Sheet, Wood-Bits, Nails, Hammer, Specimen/Model of Shed
Session Conduction Process	**Step-I:Time-10 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will discuss about house truss and shed, their necessity and importance 2. S/he will reflect on different types of truss and shed common in various areas through multi-media or picture or drawing on the board 3. S/he will initiate participatory discussion on the utility of truss and shed 4. S/he will then gradually engage in discussion on various houses we live in and their importance by way of picture display in multi-media; discussion will also cover the measurement of the shed of a strong and disaster-friendly house (bracing/wall plate/top tie) 5. Lastly, discussion will concentrate on measurement of wood relevant to different parts of a disaster-friendly house, estimated cost of various measurements of wood as well as wood treatment and maintenance

Session Conduction Process (Contd.)	**Step-III:Time-20 Minutes** 1. Facilitator will resort to question-answer to discuss on the construction strategy of truss and shed as prevailing in the area 2. After knowing the problems around the truss and shed, s/he will share the reasons behind such problems and way to solution thereof 3. Later, s/he will share the disaster-friendly technology available from the Caritas-implemented pilot project by way of multi-media/picture/model
	Step-IV:Time-10 Minutes S/He will reflect on disaster risk reduction strategy in respect of truss and shed and share the same with the participants with the help of picture/model
	Step-V:Time-10 Minutes Facilitator will seek participants perception of the following as part of evaluation process through question-answer 1. What are the importance of truss and shed in house construction? 2. Where are the rafter, bracing, wall plate, shaft, etc., are used and what would be their respective measurement? 3. Which sustainable technology is relevant to truss and shed construction common in the area? 4. What materials/ingredients are required and used to enhance the sustainability of truss and shed? 5. What measures need to be considered for disaster risk reduction while preparing truss and shed? 6. What are the ways to maintain truss and shed involving minimum cost? Facilitator might be required to reiterate points/issues as s/he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Truss and Shed)

Roof Truss

Some kind of lid/canvas is placed on wall and/or pillars of a house to cover it; roof truss is the frame set on the wall/pillars for such covering. Covering/canvas is placed on this roof truss/shed. Roof truss is very indispensable and important for the house. Roof Truss/Shed might be made of bamboo, wood, iron angle, etc., based on landlord's financial capacity, local hazard/disaster perspective, local custom/practice, etc.

Vital Parts of Roof Truss

Wall Plate/Shaft

Wall plate is placed on the main wall or the pillar of the house. Wall Plate keeps the roof truss/shed complete with tie-beam, rafter, bracing, etc., in tact as well as transfers the weight of the roof truss onto the wall or pillar.

Construction Strategy of the Wall Plate/Shaft

1. Wall Plate must be formed of mature wood or bamboo
2. Wall Plate size differs on account of the material/element used: 3"x2" inch for wood, 3" inch dia for bamboo, 1.5"x1.5"x0.125" inch for iron angle
3. There should not be any joint in case of wood within 10' feet; and grooved lap joint would have to be used where the length is more than 10' feet
4. In respect of earthen wall, the wall plate has to be dipped into 1.5' feet below through fastening with GI wire or nylon rope
5. Where RC pillar matters, wall plate is to be tied tight with an extended rod on its top; or perforated wall plate is to be fitted tight with the pillar by nut and bolt placed on it
6. In case of bamboo wall, wall plate has to be tied tight with the carved U-type groove atop the bamboo using GI wire or nylon rope
7. As to brick wall, perforated wall plate is to be fitted tight with the pillar by nut and bolt placed on it
8. Additional or visible part of wire, rod, angle and nut-bolt has to be painted with anti-corrosive colour so as to combat rust
9. Wood and bamboo have to be seasoned before use to make it sustainable and long lasting
10. Brownish oil or Kerosene oil or heated Mobil is to be smeared/polished with wood and bamboo as a measure to check insect-attack
11. Anti-corrosive paint is to be used in respect of angle

Picture 80: Strategy to prevent house shed from being blown away by strong wind

Cross Beam/Tie Beam

Cross-beams and Tie-beams are utilized to hold in safety the roof truss made of rafter and purlin for covering the house and also to transfer its weight onto the wall or pillar. They are also used to set the ceiling properly. In addition, cross-beam and tie-beam have a contributory role to retain the truss in its designated location as well as to brave any twist or movement in the face of wind. King post or Queen post is placed on the cross-beam and tie-beam.

Construction Strategy of Cross-beam/Tie-beam

1. Cross-beam and Tie-beam are sourced from wood, bamboo and angle
2. Wood or bamboo must be mature to make cross-beam and tie-beam
3. Wood or bamboo has to be seasoned prior to use for the sake of longevity and sustainability
4. Their size varies in view of the breadth of the house. Upto 11' feet breadth, cross-beam and tie-beam will be minimum of 5"x2" inch size for wood, at least 3" inch dia for bamboo and at least 1.5"x1.5"x0.125" inch for iron angle
5. Where the breadth is between 11' feet and 13' feet, cross-beam and tie-beam will be minimum 5"x3" inch size for wood, minimum 3" inch dia for bamboo and minimum 2"x2" inch for iron angle

6. Avoidance of joints in tie-beam is must, otherwise, lap joint is suggested in case of compulsion
7. Number of cross-beams and tie-beams is generally dependent on the total number of rafters
8. In respect of wood, twisted nails are required to set cross-beams and tie-beams with the wall plate, and twisted nails would have to be screw-driven into the wall plate and not beaten or thrashed in any case. Resultantly, possibility of the tie beam being loosened or unfastened in the face of wind will be remote. Simple nails may be used in other points/places.
9. Brownish oil or Kerosene oil or burnt Mobil is to be smeared/polished with wood and bamboo as a measure to check insect-attack .
10. Anti-corrosive paint is to be used in respect of angle

Rafter

Rafter is set on the wall plate to place house covering and other parts on the latter. Roof truss/shed along with the clamp/purlin is built on the rafter. Avoidance of joints in making out rafter is indispensable.

Construction Strategy of Rafter

1. Rafter must be formed from mature wood or bamboo
2. Rafter size varies according to the breadth of the house. Upto 11' feet breadth; rafter will be minimum of 2"x2" inch size for wood, minimum 3" inch dia for bamboo and at least 1.5"x1.5"x0.125" inch for iron angle
3. Where the breadth is between 11' feet and 13' feet, rafter will be minimum of 2.5"x2.5" inch size for wood, minimum 2.75" inch dia for bamboo and minimum 2"x2"x0.1875 inch for iron angle
4. Where the house is within 11' feet breadth, top-tie has to be used to hold two rafters in safety and to contain excessive wind pressure. Size of the top-tie will have to be compatible to that of the clamp/purlin. Top tie has to be set at the confluence of two rafters and 1/3 (one-third) height distance of tie beam (above the meeting point of two rafters)
5. King Post is to be set if the breadth of the house exceeds 11' feet and Queen Post is to be set if the breadth of the house exceeds 13' feet; Size of the king post and queen post should be the same as rafter's size.
6. Placement of Rafter is dependent on its size; it is generally set every 2.5 feet
7. Wood Rafter and Bamboo Rafter may be alternatively placed as a measure to minimize cost
8. 04 (four) corner-rafters have to be in place in respect of four-sided roof truss/shed. Where the breadth of the house is 11' feet, two rafters each of the size 2.5"x2.5" inch minimum for wood and 1.5"x1.5"x0.1875 inch minimum for iron angle have to be fixed; and in case of the house having 11' to 13' feet breadth, two rafters each of the size 3"x3" inch minimum for wood and 2"x2"x0.1875 inch minimum for iron angle have to be fixed
9. Rafter has to be fixed with wooden and bamboo wall plate using twisted nails; and twisted nails would have to be screw-driven into the wall plate and not beaten or thrashed; rafters have to be fastened at the same time with the wall

plate through the hurricane strap. As a result, detachment of the both out of wind pressure will have scant possibility. Simple nails might be used in other points/locations

10. At least two nails have to be inserted in any joint; one-nail joint will be very weak
11. Wooden corner rafter is better to be used for bamboo rafter
12. Where iron angle matters, rafter is to be fixed with wall plate through nut and bolt or welding
13. And in respect of bamboo, rafter is to be fixed with wall plate through wire, nylon rope, rope, etc.
14. Anti-corrosive paint is to be applied to the visible/additional parts of the wire, rod, angle, nut and bolt, etc., so as to combat rust
15. Seasoned timber and bamboo have to be used to make for sustainable and long-lasting rafter
16. Brownish oil or Kerosene oil or burnt Mobil is to be smeared/polished with wood and bamboo as a measure to combat insect-attack
17. Anti-corrosive paint is to be applied in respect of angle

Clamp/Purlin

Clamp/Purlin is set on the rafter to place the roof truss/shed of the house thereon. Wooden or Angle clamp/purlin is in general use.

Construction Strategy of Clamp/Purlin

1. Clamp/Purlin is to be sourced from mature bamboo
2. Wooden Clamp/Purlin is to be used for both wooden and bamboo rafter
3. Clamp/Purlin size for wood and angle will be respectively of minimum 2.5”x1” inch and 1.5”x1.5”x0.125” inch
4. Size and number of Clamps/Purlins will depend on rafter’s length and distance
5. Seasoned timber has to be used to ensure sustainable and long-lasting Clamp/Purlin
6. Brownish oil or Kerosene oil or burnt Mobil is to be smeared/polished with wood as a measure to check insect-attack
7. Anti-corrosive paint is to be applied in respect of angle

Estimated Cost of a House Frame measuring 18’ length x 10’ breadth

Wooden Cross-Beam

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wall Plate (Wood 3”x3”) (Bamboo minimum 3” Dia)	60 Cft.	30.00	1,800.00
Cross Beam/Shaft (Wood 5”x2”/ 12’ long)	72 Cft.	50.00	3,600.00
Rafter (Wood 2.50”x2.50”/ 9’ long)	14 Ea	200.00	2,800.00
Clamp/Purlin (Wood 2.50”x1”)	350 Rft..	10.00	3,500.00
Hardware Materials	Lump Sum	---	2,600.00
Artisans’ Wages (House Frame and Truss & Shed)	---	---	8,500.00
		Grand Total	**22,800.00**

Bamboo Cross-Beam

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wall Plate (Wood 3”x2”) (Bamboo minimum 3” Dia)	60 Cft.	30.00	1,800.00
Cross Beam/Shaft (Bamboo 3” Dia)	06 Ea.	200.00	1,200.00
Rafter (Bamboo 2.75” Dia)	14 Ea	150.00	2,100.00
Clamp/Purlin (Wood 2.50”x1”)	350 Rft..	10.00	3,500.00
Hardware Materials	Lump Sum	---	2,600.00
Artisans’ Wages (House Frame and Truss & Shed)	Lump Sum	---	8,500.00
		Grand Total	**19,700.00**

Session VIII

Subject: House Roof/Covering/Canopy
(Eighth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To describe about House Roof/Covering and its importance 2. To narrate the technique and strategy of framing a House Roof/Covering 3. To reflect on the utility of living under a disaster-resilient House Roof/Covering 4. To describe clearly about the maintenance of a House Roof/Covering 5. To explain the disaster risk reduction aspects/issues to be considered in respect of preparing a House Roof/Covering and inform others accordingly
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Displaying the ingredients/materials for house roof/covering and Experience sharing
Materials	Board, Marker, Masking Tape, Pin, Brown Paper, Nails, Ingredients/Materials for preparing a house roof/covering
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will attempt at a definition of house roof/covering, reflect on its various types, its importance, display the ingredients/materials required to prepare a house roof/covering as well as its cost 2. S/he will narrate the strategies of setting a house roof/covering and practically demonstrate these with the help of a picture 3. Lastly, s/he will deal with the utility of the house roof/covering
	Step-III:Time-15 Minutes Facilitator will resort to practical demonstration or picture display to narrate what aspects/issues are relevant to disaster risk reduction while preparing a house roof/covering
	Step-IV:Time-00:10 Minutes Facilitator will seek participants understanding about the following as part of evaluation process through question-answer: 1. What is house roof/covering, its importance, advantages and disadvantages? 2. What measures need to be considered for disaster risk reduction while preparing a house roof/covering? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Roof)

House Roof/Covering

House Roof is meant to act as a canopy over the house truss/shed placed on the wall or pillars. We find various kinds of house roof framed with different materials like dry straw, *chhawn pata* (local variety) / dry leaves, jute stick, bamboo splits, polythene, asbestos sheet, colour sheet, CI sheet, RC materials, etc. depending on financial ability of the landlord, house type, local hazard perspective, local custom/practice, etc.

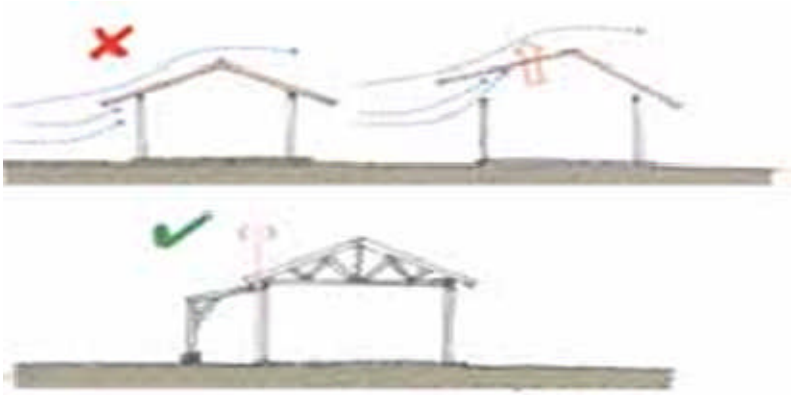
Construction Strategy

1. House Roof is formed with the materials like dry straw, *chhawn pata*/dry leaves, jute stick, bamboo splits, polythene, asbestos sheet, colour sheet, CI sheet, RC materials, etc., to act as a canopy covering the Clamp/Purlin of the House Truss/Shed
2. ***House Roof formed with one or the other of dry straw, chawn pata/dry leaves, jute stick, bamboo splits***: dry straw, *chhawn pata*/dry leaves, jute stick, bamboo splits, etc., have to be spread all over the Clamp/Purlin of the House Truss/Shed and strongly tied with jute rope, nylon rope, plastic rope, bamboo cane, galvanized wire, etc.; later, there has to be another round of materials setting in the same way on the first line, sparing half or some part/area of the line (previous lining); full house truss/shed will thus be covered in stages with house roof.
3. ***House Roof formed with polythene***: polythene sheet has to be spread all over the House Truss/Shed (except Clamp/Purlin) and strongly tied with bamboo splits, jute rope, nylon rope, plastic rope, galvanized wire, etc., to cover the full house truss/shed.
4. ***House Roof formed with colour sheet or CI sheet***: one line 1.5 wave lapping by colour sheet or CI sheet has to be completed over the Clamp/Purlin of the House Truss/Shed and strongly tied with Clamp/Purlin using roofing screws or nails; later, at least 6" portion of upper part of the first line has to be filled-in, or otherwise lapped, and colour sheet or CI sheet is to be tied in the same way in the second round. Full house truss/shed will thus be covered in stages with house roof. Upper meeting part at the four corners of the roof is to be linked/adjusted with ridging roofing screw to effect above.
5. Colour sheet or CI sheet is to be set properly with careful calculation/measurement at the four corners of the roof in case of four-side roof to complete house roof/shed. The sheets have to be carefully handled while chopping, so that left-over part is not wasted away.
6. Anti-corrosive paint may be applied to CI sheet to guard against any rust and enhance house roof longevity
7. Roofing screws have to be screw-driven, and not thrashed into, the Colour sheet or CI sheet in all areas including the cyclone and storm belt. Nut has to be used along with washer; dented nails might also be tried. Part of the nail stretched/extended below the wood has to be bent.
8. In addition to Colour sheet or CI sheet, there has to be at least 1.5 wave lapping and one horizontal lapping of minimum 6" inch over another lapping

9. Rafter wood has to be extended 2” below from the terminal portion of Colour sheet or CI sheet (rafter top to be slopped from the sheet)
10. Each CI sheet must contain 03 (three) roofing screws/horizontal nailing; there has to be at least three-line roofing screw/nailing for 9’ feet long sheet
11. House roof needs to be set at minimum 30-degree and maximum 40-degree angle as a measure to prevent the roof from being flown away in the face of wind
12. For the same reason, house roof should be four-sided rather than two-sided
13. House roof has to be strongly tied with the main house framework to avoid damage/being blown off out of severe wind pressure
14. The less is the extended part of the house roof, possibility of wind-triggered damage is scant
15. All the constituent parts of the house roof have to be properly fixed / adjusted with the pillars. Roof is to be strongly fixed with ring beam utilizing galvanized nut-bolt, screw, nails and other metal frame. House roof rafter has to be directly fixed with ring beam through hurricane strap.
16. Two rafters at the top have to be fixed side by side using hurricane strap
17. CI sheet has to be strongly fixed using adequate number of galvanizing roofing screws as well as dented iron as a measure of protection against wind
18. Balcony structure/frame has to be separate from the main house, so that the latter is not damaged even if the balcony is blown away out of wind
19. Joints in the wood have to be strong and impregnable. Wooden frame has to be properly anchored within the foundation through nut and bolt, so that frame is not de-linked from the base.

Pictures depicting issues/matters relevant to House Roof

Picture 81: House roof should be four-sided rather than two-sided as a measure to prevent the roof from being blown away in the face of wind (Sketch Credit-IFRC)

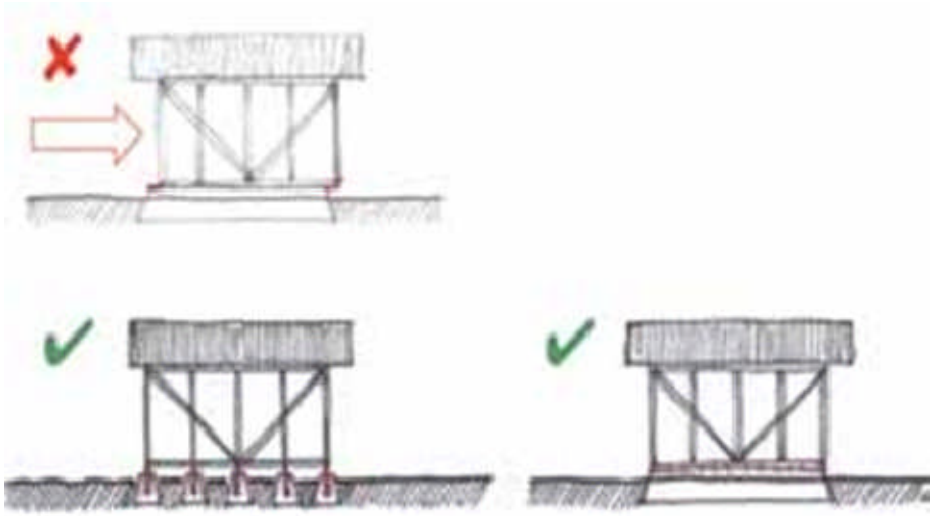


Picture 82: House roof has to be strongly tied with the main house frame to avoid damage whatsoever out of severe wind pressure (Sketch Credit-IFRC)

Picture 83: If the extended part of the house roof is between 08" inch to 1' foot, possibility of wind-triggered damage is scant (Sketch Credit-IFRC)

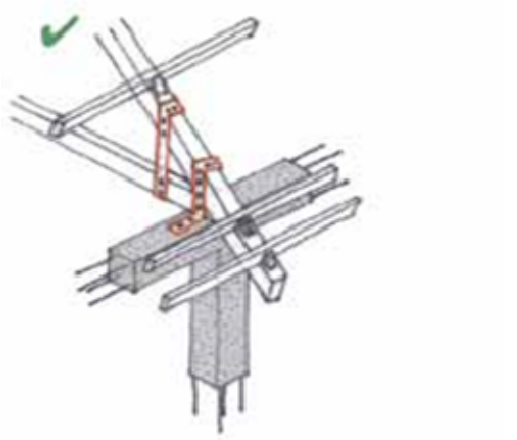
Pictures depicting issues/matters relevant to House Roof

Picture 84: House roof needs to be set at minimum 30-degree and maximum 40-degree angle as a measure to prevent the roof from being blown away in the face of wind (Sketch Credit-IFRC)

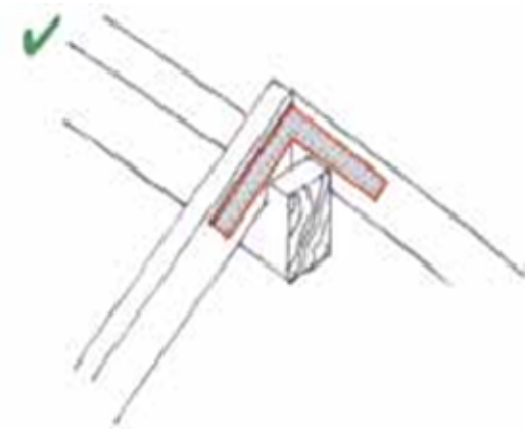


Picture 85: Joints in the wood would have to be strong and impregnable; wood-frame has to be properly anchored within the foundation through nut and bolt, so that frame is not de-linked from the base. (Sketch Credit-IFRC)

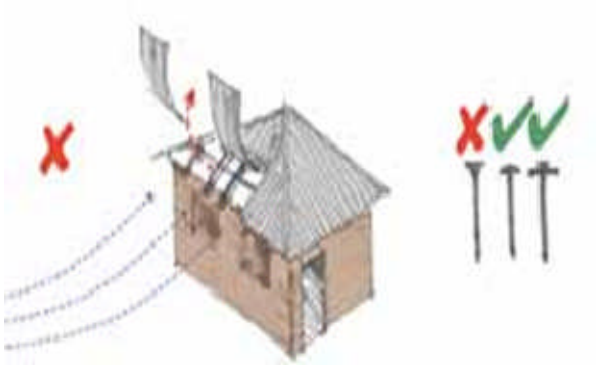
Pictures depicting issues/matters relevant to House Roof



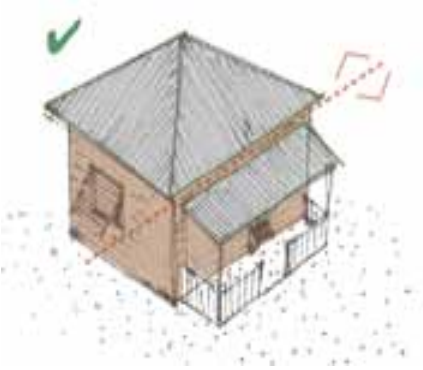
Picture 86: House roof rafter has to be directly fixed with ring beam through hurricane strap (Sketch Credit-IFRC)



Picture 87: Two rafters at the top would have to be fixed side by side using hurricane strap (Sketch Credit-IFRC)



Picture 88: CI sheet has to be strongly fixed using adequate number of galvanized roofing screws as well as dented iron as a measure of protection against wind (Sketch Credit-IFRC)



Picture 89: Balcony structure/frame has to be separate from the main house, so that the latter is not damaged even if the balcony is blown away out of wind (Sketch Credit-IFRC)

Estimated Cost of House Roof made of CI Sheet

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
CI Sheet for main House (0.32mm/9')	22 Ea	650.00	16,800.00
CI Sheet for Balcony (0.32mm/7')	11 Ea	560.00	7,160.00
Ridges (0.24mm)	14 Ea	160.00	2,240.00
Materials for house roof fitting (Screw, Nail, Rubber Washer, Nut-Bolt)	Lump Sum	---	3,000.00
		Grand Total	**29,200.00**

Session IX

Subject: House Bracing
(Ninth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define Bracing and reflect on its importance 2. To narrate clearly the technique and strategy to make out a Bracing 3. To describe about the advantages, disadvantages and cost of Bracing 4. To describe clearly about its maintenance 5. To explain the disaster risk reduction aspects/issues to be considered while forming a Bracing and inform others accordingly
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Display of Bracing model, Experience sharing, etc.
Materials	Board, Marker, Masking Tape, Pin, Brown Paper, Nails, Wood, Hammer, Saw, Bracing model, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-15 Minutes Facilitator will define bracing, and reflect on its importance, utility and construction strategy with the help/display of bracing model
	Step-III:Time-20 Minutes Facilitator will resort to practical demonstration with model display to narrate what aspects/issues are relevant to disaster risk reduction while framing a bracing
	Step-IV:Time-10 Minutes Facilitator will seek participants perception of the following as part of evaluation process through question-answer: 1. What is bracing, its importance, advantages and disadvantages? 2. What measures need to be considered for disaster risk reduction in respect of bracing? Facilitator might be required to reiterate points/issues as s/he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Tip for the Facilitator

The Facilitator is required to consult various books, reports, updates, etc., relating to this topic apart from the module in order to gain clear concept of the subject matter; s/he might also try to collect any other relevant case-study to bolster his perception.

Facilitator's Guide

(House Bracing)

Cross Bracing

Cross Bracing is set with wood in a slanting direction between two pillars of the house. Cross bracing is to be effected by diagonally placing the wooden element across the two pillars dug in the two corners of the house according to the picture. Wood size in this respect would be 3"x2.5" inch. Thick and coarse rope or thin wire may also be used for cross bracing.

Bondage created between two pillars out of cross bracing as noted above prevents any leaning trend or movement whatsoever of the house in the face of storm or severe wind. Bracing has to be vertical, diagonal and corner-wise to fetch a firm wood-frame. In the same way, there has to be plenty of vertical, diagonal and corner-wise bracings in the fence to ensure a firm house fencing.

Estimated Cost of Cross Bracing

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wood 14' long and 5" dia	4 Ea	1,200.00	4,800.00
Bamboo 14' long and 3" dia	4 Ea	400.00	1,600.00
		Grand To	**6,400.00**

Corner Bracing

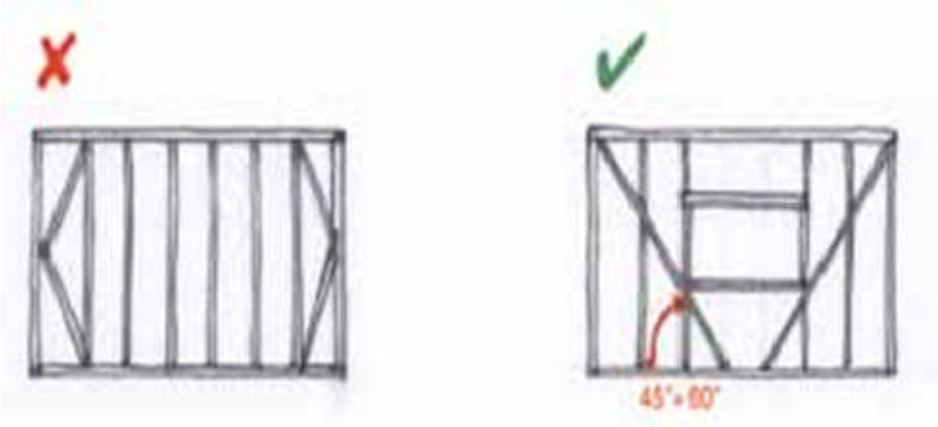
Corner Bracing is set along with wood in a slanting direction with the pillar and paiere on the upper part of the corner of the house. According to the picture, this is 3" feet long and attached with the corner pillar in 45-degree tri-angle position. Wood size for the corner bracing would be 3"x2.5" inch. It makes for bonding between the pillars and the house, obstructing any trend on the part of the house to lean and/or move in the face of wind or storm surge.

Estimated Cost of Corner Bracing

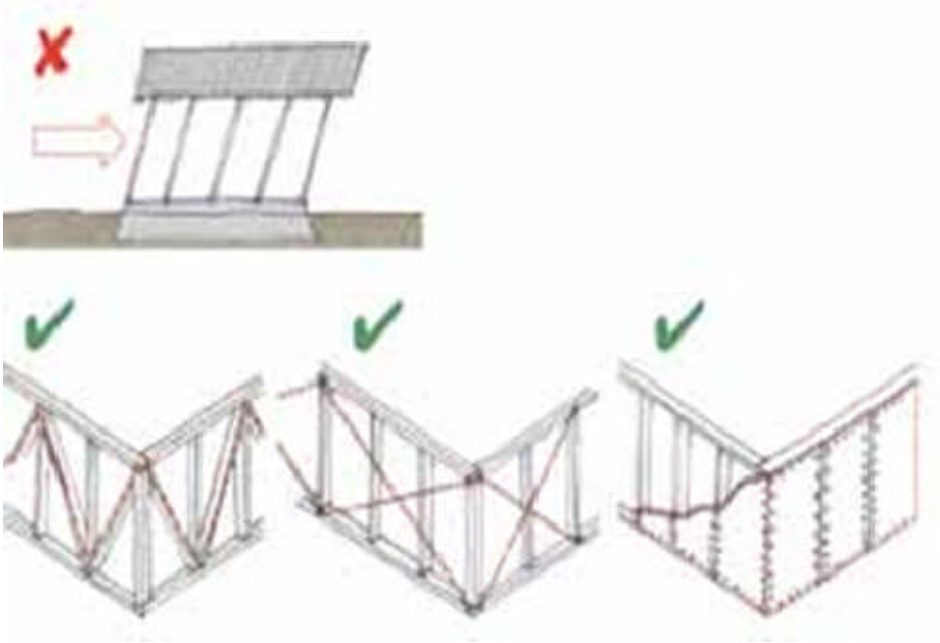
Corner Bracing made of Wood

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Mehogony Wood 3'	1.2 Cft.	1,000.00	1,200.00
Artisans' Wages	Lump Sum	---	1,000.00
		Grand Total	**2,200.00**

Pictures depicting issues/matters relevant to House Bracing



Picture 90: There has to be properly set vertical, diagonal and corner-wise bracing to ensure a firm wooden frame (Sketch Credit-IFRC)



Picture 91: Adequate number of vertical, diagonal and corner-wise bracings have to be set in the house fence in order to strengthen the fence (Sketch Credit-IFRC)

Pictures depicting issues/matters relevant to House Bracing

Pictures 92 & 93: Various types of cross bracing

Pictures depicting issues/matters relevant to House Bracing

Pictures 94 & 95: Various types of corner bracing

Session X

Subject: House Ceiling
(Tenth Step towards House Construction)

Objective	**This Session will enable the Participants** 1. To define Ceiling and describe its importance 2. To narrate clearly the technique and strategy to make out a Ceiling 3. To describe about the advantages, disadvantages and cost of Ceiling 4. To describe clearly about its maintenance 5. To explain the disaster risk reduction aspects/issues to be considered while developing a Ceiling and inform others accordingly
Time	50 Minutes
Methodology	Lecture, Discussion, Question-Answer, Display of Ceiling, Demonstrating Ceiling Materials, Experience sharing, etc.
Materials	Board, Marker, Masking Tape, Pin, Brown Paper, Ceiling Model, etc.
Session Conduction Process	**Step-I:Time-5 Minutes** Facilitator will exchange greetings and initiate day's session; at the very outset, s/he will write out the topic and objective on the board or poster paper.
	Step-II:Time-20 Minutes 1. Facilitator will define ceiling, reflect on its importance and discus about different types of ceiling 2. S/he will refer to various materials required to develop a ceiling, show its formation strategy and describe the utility of house roof
	Step-III:Time-15 Minutes Facilitator will resort to practical demonstration with model display to narrate what aspects/issues are relevant to disaster risk reduction while developing a ceiling
	Step-IV:Time-10 Minutes Facilitator will seek participants understanding about the following as part of evaluation process through question-answer: 1. What is ceiling, its importance, advantages and disadvantages? 2. What measures need to be considered for disaster risk reduction in respect of ceiling? Facilitator might be required to reiterate points/issues as he deems appropriate for the sake of participants clarity; then s/he will wrap up the session with vote of thanks

Facilitator's Guide

(House Ceiling)

Ceiling

Ceiling forms an important part of the house which safeguards and shields the inmates from sunshine heat and winter cold; light household items can also be stored / preserved thereon, especially during flood. It beautifies house setting. Family members can stay/live on the ceiling during flood, if it is made hard, strong and high enough. Ceiling is generally made of bamboo splits and bamboo lath/clamp.

Advantages and Disadvantages of a House Ceiling made of (i) Bamboo Splits, (ii) and Wood

Ceiling Detail	Advantages	Disadvantages
Ceiling from Bamboo Splits	1. Skilled Artisan is not required 2. Controls the room temperature (heat and cold) 3. Adds to house beauty and elegance 4. Light valuable household items can be stored / preserved at the time of flood 5. Little time is required for its framing	1. Comparatively less strong or sustainable 2. Bulk/weighty items cannot be stored
Ceiling from Wood	1. Controls the room temperature (heat and cold) 2. Adds to house beauty and elegance 3. Valuable household items can be stored and temporary accommodation ensured at the time of flood 4. Comparatively more strong or sustainable	1. Comparatively costly 2. Skilled Artisan is required 3. Comparatively much time is required for its formation

Comparative Cost Analysis to develop a Ceiling

Ceiling made of Bamboo

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Bamboo Splits	180 Sft.	25.00	4,500.00
		Grand Total	**4,500.00**

Ceiling made of Wood

Item Detail	Quantity	Unit Price (BDT)	Total Amount (BDT)
Wood	16 Cft.	850.00	13,600.00
Artisans' Wages	Lump Sum	---	2,500.00
		Grand Total	**16,100.00**

Estimated Budget of a Disaster-resilient Low-cost House

House Size (Four-sided Roof): 18'-00"x10'-6"x6'-00"

STEPS	1ST MODEL	2ND MODEL
First: **Layout**	500.00	500.00
Second: **Base/Foundation**	800.00	2,000.00
Third: **Plinth**	2,400.00	2,900.00
Fourth: **Pillar**	6,620.00	17,400.00
Fifth: **Fence**	19,200.00	19,200.00
Sixth: **Doors & Windows**	6,500.00	15,000.00
Seventh: **Truss**	19,700.00	22,800.00
Eighth: **Roof/Canopy**	28,760.00	28,760.00
Ninth: **Corner Bracing**	1,000.00	2,000.00
Tenth: **Ceiling**	4,500.00	4,500.00
Total Amount(BDT)	**89,980.00**	**115,060.00**

(Concluded)